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VOL. LXXXVII. JULY 9, 1920. No. 2,224.

ELECTRICAL REVIEW.

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A GREAT GERMAN ELECTRICAL SYNDICATE.

IT is comprehensible that just as manufacturers in each branch of industry in this country loyally co-operated with each other during the years of war, so in Germany and other countries concerned was a similar mutuality of interests recognised by the producing works in those countries. It is, however, not so well known that some of the lessons of the war and the probable results of the Treaty of Peace have been so thoroughly learned by German electrical firms, that their relations have been materially strengthened since the Armistice, with the object not only of conducting business in the inland market with a degree of competition that is less than in former periods of peace—even if there is to be any rivalry whatever in the home market in the future—but also of promoting the export trade on a scale larger than that which prevailed in 1913. Rightly or wrongly, it is claimed for the German electrical industry that its total production seven years ago was greater than the combined output of all other electrical firms in the whole of the rest of Europe. This claim is based upon the development due to the expansion of both the big firms and those of lesser importance in their individual capacity, but times have changed, and the firms have changed with them, and are adapting themselves to present and future conditions for the re-assertion, if possible, of their position in the markets of the world.

No shadow of doubt exists on this question, judging from the proceedings at the second general meeting which has just been held in Berlin of the Central Syndicate of the Electrotechnical Industry (Zentral Verband der Elektrotechnischen Industrie), which comprises a membership of 388 firms, employing approximately 240,000 workers and officials. These figures are so large as to lead to the assumption that most of the electrical firms in that country have joined the syndicate, which, while not exercising any control over the production of the members individually, has a regulating influence on prices in the home market. It is uncertain whether the activity of the syndicate will also apply to export prices, although it seems as if these will also be brought within its scope; otherwise the statement would not be made that the importance of the Teutonic production, as a whole, will ensure German firms a joint influence in the development of the world's market prices in the long run, and that as a united branch the electrical industry is very probably able to co-determine the foreign market at the present time. As far as concerns the trade transacted since the Armistice, it was asserted at the meeting that the exports of electrical manufactures in 1919 represented 25 per cent. of the quantity in 1913, while the quantity has risen to the equivalent of 40 per cent. in the months of the present year. It is impossible to say whether these figures can be relied upon, as the publication of the official statistics has not yet been resumed or rendered available to the public.

The situation of the inland market was also discussed at the meeting. It was mentioned that customers, particularly retailers, partly for speculative purposes, had given orders which were far in excess of the market's capacity for absorption, and this fact and the difficulties experienced in procuring materials had induced makers to cover their requirements in raw materials by the placing of large orders. As these materials are now more abundant, producers are endeavouring to deliver as rapidly as possible and to com-

plete the orders, but on the other hand, customers are causing difficulties, many retailers, for instance, being financially too weak to accept delivery. The circumstance of possessing large stocks of raw materials at former sale prices hampers the makers in reducing the prices of manufactures, which, however, will not as a rule bring about an increase in the consumption in such critical times. In this connection it is contended that the Price Control Department maintained by the syndicate has only followed in a hesitating manner the general upward movement of prices in the past, the addition to pre-war prices having remained at 2,500 per cent. since March in the present year.

The director of the Price Control Department, replying to attacks made on the price policy of the electrical industry—which were provoked by electrical attacks on the coal and iron and steel industries—submitted that it was impossible to exercise over electrical prices a control similar to that exercised by the Federation of the Iron and Steel Industry (the self-governing body created by the Government), owing to the multitude of electrical manufactures, one catalogue alone comprising 2,100 pages. He also stated that it had been shown in the case of the federation that the producer members, workmen members, and merchant members, whose interests lie in the same direction, vote increases in the sale prices of iron and steel without further ceremony, and thus through their majority decisions over the consumer members, legalise prices which associations of consumers would be able far more easily to contest in a free and open market, and not one controlled by the federation. The director admitted that the inland prices for electrical manufactures are at present higher than the world's market prices, while the working expenses are mostly below the world's level. Iron and steel, for instance, are still slightly less in Germany than in foreign markets, coal is considerably lower, and the wages are lower, but copper and other raw materials have to be calculated at the world's market quotations. Yet the average costs per unit of finished products are said to be higher than in other countries owing to the eight-hour day, reduced average output of the workmen, frequent strikes, &c.

It is unnecessary to refer to any of the other questions raised at the meeting. Quite enough, however, has been written to show that German industry now possesses a powerful commercial organisation, whereas a combination on such a large scale as in the present case was lacking before the great war. No doubt the promotion of the export trade will become a prominent plank in the syndicate's programme. "As a united branch," as one speaker declared and as previously mentioned, "the electrical industry is very probably able to co-determine the foreign market at the present time." It does not necessarily follow from this statement that the electrical industry is yet a united branch for the export trade, but it would not be surprising if the syndicate were expanded into such a combination in the near future.

British Water-Power.

THE second interim report of the Water-Power Resources Committee, of which we give an abstract in this issue, puts forward definite recommendations for the establishment of a controlling Water Commission, to deal with the uses of water for all purposes (not only for power) in England and Wales. A Sub-Committee appointed in November, 1918, to deal with Irish water-powers is still investigating the subject. The Committee lays stress on the great importance of the conservation and use of our water resources, which have hitherto been neglected by the State; the proposed Commission is to be placed under the Ministry of Health, but an Inter-departmental Water Committee is proposed to assist the Commission, on account of the variety of interests affected, and, in particular, it is suggested that either the Board of Trade or the Electricity Commissioners should be provided with powers and funds to promote the development of water-power. While the Electricity Commissioners have their hands pretty full already, we cannot think that any other authority or department would be better fitted than they to deal with this question to the national advantage; inevitably the generation, transmission, and utilisation of energy derived from water power will be carried out by electrical means, and will, therefore, come within their jurisdiction; the same consideration applies to the use of water for condensing in steam-power stations, and while the interests of agriculture, fisheries, navigation, and potable water supply will be watched over by the Water Commission, with the assistance of an official of the appropriate department, we trust that the greatest care will be taken to prevent obstruction and delay due to internal friction between various Government departments. A wise dictatorship is preferable to divided counsels, and in our opinion the Electricity Commission, which already possesses wide powers in connection with water-power for generating electricity, is the only body competent to deal with this branch of the subject. Any legislation that is proposed should be so devised as to facilitate to the utmost the use of water-power—which, it may be observed, need not, and should not, in any way conflict with the later use of the water for agriculture, fisheries, or any other purpose.

It is interesting to note that in the United States, where water-power in abundance is available, and where its national importance is fully realised, the Water Power Bill which recently received the overwhelming support of Congress was eventually defeated by the failure of the President to give his approval to it. The whole of the work will have to be done over again. We may be thankful that in this country, in spite of the politicians, the will of the people invariably prevails, and we need not fear a similar calamity.

Staff Employes.

IN a letter which we publish to-day in our "Correspondence" columns, the secretary of the Society of Technical Engineers responds to our suggestion that some information might with advantage be given to the engineering world regarding the position in which the Society now stands. It is gratifying to learn that the foundations have now been completed and the constitution settled, and that we may hope in the near future to be put in possession of full information regarding this new factor in the social structure, which, as Mr. Wyld remarks, has passed a long time in the embryonic state, and therefore, we trust, will be found to have developed into a highly efficient organism. Incidentally, the writer points out that, outside the electricity supply branch, Joint Industrial Councils have not been set up for the engineering manufacturing industry, and that in any event they would not meet the needs of the technical staffs, who would not be represented on the Whitley Councils. As we remarked in our leaderette, the only case in which this difficulty has been solved is that of the power station engineers, who have their Joint Board, and we note with interest that the provisional executive council of the Society of Technical Engineers is favourably disposed to the adoption of this system by other sections of the industry.

The "Joint Board" scheme, in fact, appears to us to be the only practicable method of safeguarding the interests of the technical staffs, who are at present in an anomalous position, being allied neither with the employers nor with the manual workers, and having no machinery for negotiation with either party. As we suggested, in the absence of such Joint Boards, the Society of Technical Engineers appears to be the only organisation that is capable of serving the interests of the brain-workers, and it is interesting to learn that the Society, even provisionally, endorses the Joint Board system.

It will be observed that both Mr. Wyld and another correspondent who writes in support of the Society of Technical Engineers, lay special emphasis on the fact that the staff officials constitute a third party in industry. This has only been recognised within recent years, and has not yet been brought home to the other two parties. The Society of Technical Engineers, therefore, has a practically untilled field to cultivate—a field of very wide area and of the first importance to British industry—and we shall look forward to the announcement of its proposals with keen interest.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

The Annual Convention at Ilkley.

(*Continued from page 9.*)

While we have concluded our general report of the proceedings at the Convention, and have little to add thereto, we think the accompanying snapshots may be of sufficient interest to justify their insertion. We had hoped to include a reproduction of the group taken by the official photographer at Cartwright Hall, but we find that this photograph is not to be published. For most of the views we are again indebted to the courtesy of Mr. C. H. Wordingham; the remainder are our own. One of the noticeable features of this Convention was the large number of visitors, including ladies, who took part in it; some of these, who will be readily recognised, are seen in the first group of views, which will also give some idea of the sylvan charms of Wharfedale. The other illustration shows groups of members of the Convention on various occasions and in divers kinds of conveyances.

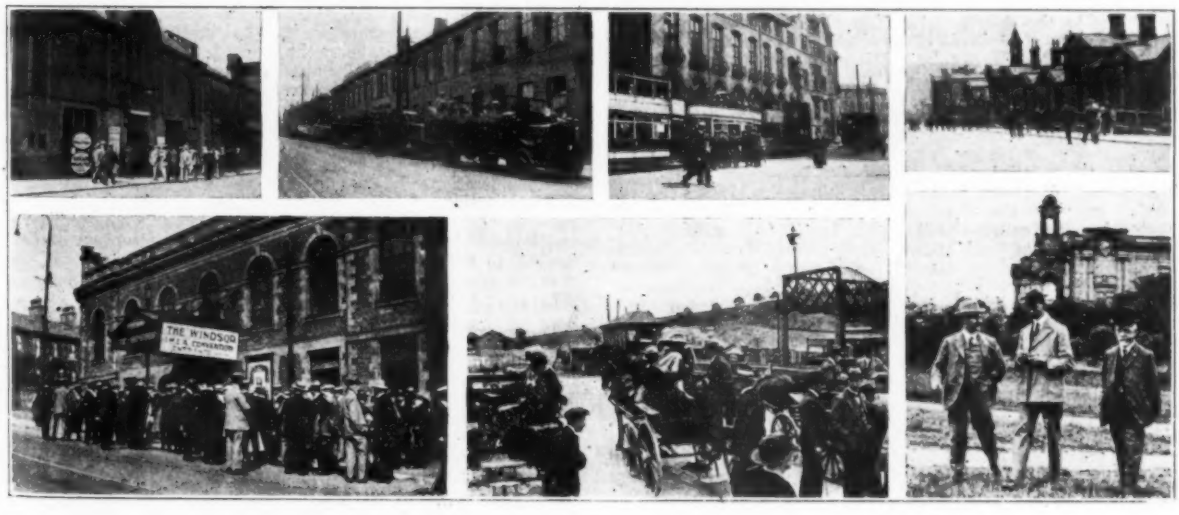
"Kindred Associations." A Corner of the Abbey. Interested Visitors.
At Bolton Abbey.

A word of praise should be recorded for the admirable organisation of the proceedings as a whole, which reflected the greatest credit on those who had shared the burden of preparation, and whose duties were so efficiently performed—not excepting the Clerk of the Weather; and we are pleased to note that at the meeting of the Bradford Electricity Committee on Friday last, a resolution of thanks was passed to a number of leading electrical and textile firms in Bradford, and the members of the Electricity Department's staff, for the facilities they afforded the delegates at the Convention.

On the occasion of the presentation to Mr. H. Faraday Proctor, he pointed out that, as a result of the operation of the national scheme, the Association would probably find it necessary or desirable to enlarge the scope of its membership, in order to provide for the admission of the officials of Joint Electricity Authorities, who would necessarily represent the companies as well as the local authorities within their areas. Under the existing constitution these officials would be excluded, and if, as seemed possible, he became one of them, he would greatly regret to have to resign his membership. The Association had always been essentially municipal in character, but he thought a branch should be formed to include such officials; otherwise a new association would come into existence. Obviously it would be highly regrettable that so valuable a member as Mr. Proctor should find no place within the Association; and many other members will doubtless be affected in a similar way.

Another question that was raised was that of admitting other electrical associations to participation in the Annual Convention. Mr. I. V. Robinson, of the B.E.A.M.A., when acknowledging the compliment paid to that Association by inviting it to contribute a paper, expressed a wish that the Convention should be expanded so as to embrace all branches of the electrical industry, and the President, Mr. Roles, received the proposal very favourably, remarking that he had long thought they might be more catholic in that respect. Possibly we may yet see developed out of the I.M.E.A. Convention a gigantic meeting of electrical men like that of the National Electric Light Association of the United States.

Fortunately, as may be gathered from our report of the Convention, the I.M.E.A. is broad-minded and progressive, and whatever form its constitution may take in the future we feel certain that its Annual Convention will continue to be held, to the great satisfaction of those who are privileged to share in it.



Headquarters, Ilkley. At the Phœnix Works. Starting for Saltaire. At Saltaire.
At the Windsor. Off to Bolton Abbey. Leaving Cartwright Hall.
At Ilkley and Bradford.

Power Station Design in Relation to Thermal Efficiency.

By I. V. ROBINSON, Wh.Sc., A.M.Inst.C.E., M.I.Mech.E.,
British Electrical and Allied Manufacturers' Association.

(Abstract.)

1.—INCREASE IN RANGE OF WORKING TEMPERATURES OF STEAM.

To improve the thermodynamic efficiency of any heat engine we are guided by a fundamental law of thermodynamics to increase the initial temperature and lower the final temperature of the steam.

The upper temperature limit has been raised by gradual steps until now steam at 650 deg. F. to 700 deg. F. is in use in many stations with success. The final limit has not yet been reached, but progress must be slow.

Pressures of 300 to 350 lb. are becoming usual for the larger stations, and units are now being constructed for higher pressures. Probably, in the near future, pressures of 500 lb. will be generally used with a total temperature of 700 deg. to 750 deg. F. for large sets.

At the same time, it must be remembered that an increase of pressure in itself decreases the thermal efficiency of a turbine for several reasons, thus:—

(*a*) An increase in the steam density involves an increase in the losses in the H.P. end of the turbine by increasing the clearance losses in reaction and the disk and windage losses in impulse turbines.

(*b*) With a constant initial temperature and, therefore, decreasing superheat with increasing pressure, the steam loses its superheat sooner and becomes wetter, thereby decreasing the blade efficiency of the L.P. end.

(*c*) With greater pressure and consequently greater available heat drop, it is necessary to provide more stages or rows to maintain the same efficiency ratio, and this is not always possible within practicable limits.

(*d*) Dummy leakage losses in reaction and diaphragm leakage losses in impulse turbines increase as the pressure increases.

Retaining a fixed initial temperature of 700 deg. an increase in pressure, by increasing the available heat drop, has a beneficial effect upon the turbine efficiency by reducing the volume of steam required for any duty, and so reducing the leaving losses from the last row of blades.

In deciding upon a high steam pressure, the extra cost of the boiler plant, pipes, valves, and turbines must be considered. In the steam turbine cast steel should be used for all parts subjected to temperatures of 500 deg. F. or above.

Whilst considerable improvement has been made by using higher vacuum, there is naturally not so much scope as with the upper temperatures. With a natural supply of circulating water from river or sea in the North, at a temperature of, say, 55 deg. F., a vacuum of 29-in. can be obtained economically. With cooled water a temperature of 75 deg. to 80 deg. can be obtained under the average atmospheric conditions, according to the rating and design of the towers, and with this a vacuum of 28 in. is economical. In some cases, where water at 50 deg. F. can be obtained, a vacuum of 29.1 in. has been used. Beyond this vacuum, corresponding to a bottom temperature of 76 deg. F., no considerable progress towards lower temperatures can be made.

Owing to the difficulty of providing sufficient area through the last row of blades for turbines working with a high vacuum, the relative turbine efficiency is usually lower with high vacua. With all high-vacua turbines the kinetic energy carried away by the steam after leaving the last row of blades (usually called the "leaving loss") is a considerable proportion of the total losses. An increase from 28 in. to 29 in. vacuum doubles the volume of steam at the exhaust, and with the same blading would increase the leaving losses fourfold. By providing higher blades in the last row the area is increased considerably, but still it is almost impossible to provide such area as is required to keep the leaving losses at the 28-in. figure. Higher vacua, therefore, reduce the relative thermal efficiency of the turbine, but effect an over-all improvement in the steam consumption.

In determining upon the use of a high vacuum full consideration must be given to the cost of obtaining it, expressed both in capital charges on more expensive plant and increased operating costs due to larger pumps.

2.—SAVING OF LOW-GRADE HEAT.

Some progress has been made with this problem in two directions:—

(*a*) By heating the condensate to comparatively high temperatures, using steam tapped from the main turbine, and

(*b*) By reheating the steam after partial expansion in the turbine until the original superheat is restored.

Considerable progress has been made in the direction of higher feed heating, and a good case can be made out for raising the temperature to 150 deg. F. for the average boiler house with economiser and to 300 deg. F. if suitable arrangements are made to utilise the heat in the flue gases to heat the air supplied to the furnaces. The heat carried away by the circulating water is approximately 1,000 B.TH.U. per lb. of steam condensed. If steam be abstracted from the turbine at a suitable point (or points) and used in a surface feed heater to heat the condensate coming from the main condenser, the latent heat of the steam so abstracted is returned to the boiler and not rejected to the circulating water. Assuming that 10 per cent. of the steam is withdrawn at suitable points, and that the condensate leaves the condenser at 75 deg. F., its temperature would be raised about 100 deg. in the surface heater and low-grade heat saved to the extent of 1,000 heat units per lb. of tapped steam which would otherwise have been lost to the system. With about 23 per cent. of the total steam tapped the feed could be raised in temperature about 225 deg., giving a total temperature of 300 deg. F.

Steam should not be tapped for heating until it has lost all its superheat, as it is most efficient in the turbine when superheated, and is, in that condition, most inefficient as a heating medium in a surface heater.

The effect upon the turbine efficiency is a slight improvement in spite of the fact that low-pressure blades in steam turbines are more efficient than high-pressure ones due to reduction of tip clearance losses or diaphragm leakage and disk or windage losses. Thus in the L.P. blades the indicated efficiency may be 85 per cent., but at the H.P. end only 65 per cent. to 70 per cent. As more steam has to be passed through the H.P. end to compensate for the steam abstracted before the L.P. blades are reached, there is some loss of efficiency, but most of this is regained by the resultant lower steam velocities in the L.P. blades. With high-vacuum turbines, the leaving loss may amount to 3.0 per cent. of the available heat drop of the turbine. If, as assumed previously, 23 per cent. of the steam is abstracted for feed heating, the velocity is reduced nearly proportionately, and the leaving losses, which vary as the square of the velocity, are reduced from 3.0 per cent. to about 1.8 per cent.

For this reason the overall efficiency ratio of the turbine is slightly improved, but, of course, as the heat available for useful work in the turbine is reduced, an increased quantity of steam has to be supplied to the turbine.

The flue gas temperature could be reduced even below the normal figure attained with feed water at 100 deg. F. by using the economiser, in a modified form, for heating the air supplied to the furnaces. As the air would enter this air heater at a low temperature the flue gases could be reduced to a very low temperature and induced draught used. Such an air heater with flue gases and air on the two sides of the tubes would probably have to be much larger than the usual economiser to absorb an equal amount of heat.

Instead of heating the feed entirely by tapped steam, tapped steam could be used to raise the temperature as high as needed and steam from auxiliaries used for the final heating.

The second method of saving low-grade heat, re-heating the steam after partial expansion, has not yet been applied as a commercial proposition. Extensive experiments were made some years ago, but no permanent adoption of the principle resulted therefrom. The theoretical gains to be anticipated from reheating the steam have been developed very completely in an address recently given by Mr. W. M. Selvey before the I.E.E.* Quoting from that address, it appears that, starting with steam at a pressure of 500 lb. per sq. in. absolute, superheated to 688 deg. F., the best result is given by two reheats to the same initial temperature at pressures of 150 or 215 lb. absolute for the first reheat and 45 or 50 lb. absolute for the second.

The overall efficiency may be increased by two reheats in the ratio of 39.37 to 37.76 per cent. Against this theoretical saving of 4.1 per cent. in the coal bill have to be set the annual charges on the extra cost of the inter-heaters and the cost of operation. It therefore appears very doubtful whether the application of reheating would be a commercial proposition at present. Attention to feed heating by auxiliary and tapped steam from the turbine will repay attention much more than reheating.

3.—SIZE OF GENERATING SETS.

In considering the maximum size of generating sets the limiting factors are not concerned with the actual design and construction, but rather with the question of transport. Given the demand, there are no insuperable difficulties to prevent any suitably equipped shops turning out a turbine for a normal output of 100,000 KW.

The maximum output varies inversely with the square of the speed, the vacuum (29 in.) and leaving losses (2½ per cent.) remaining constant. The following outputs are obtainable at the speeds stated:—

860 r.p.m.	...	100,000 K.W.	1,500 r.p.m.	...	33,000 K.W
1,000 ,,	...	74,000 ,,	18.00 ,,	...	22,900 ,,
1,200 ,,	...	52,000 ,,	2,400 ,,	...	12,800 ,,

Machines are now being built or are running for outputs of 10,000 KW. at 3,000 R.P.M. and 16,000 KW. at 2,400 R.P.M., but no machine is yet on order in this country for the output stated above for 1,500 R.P.M., the largest being 25,000 KW. In the United States a 45,000-KW. set is running at Detroit at a speed of 1,000 R.P.M.

The desirability of turbines of the maximum size is quite another matter, as is also the question whether there is any need for sets of outputs above, say, 30,000 KW. normal. The two main considerations leading to the adoption of larger units are:—

1. Reduced operating costs, the chief item being the steam consumption, and
2. Reduced capital cost.

* ELECTRICAL REVIEW, February 6th, 1920, p. 187.

The curve of steam consumption against normal capacity becomes very flat after an output of 20,000 to 25,000 KW., and in the present stage of the art of turbine design, there is no decided advantage in going beyond 30,000 KW. normal capacity. A very similar limit is reached when the question is approached from the viewpoint of capital cost. Already rail transport is impossible with the larger portions of 15,000 to 20,000-KW. sets, and the cost of road transport rises very rapidly with weight of parts handled. The capital cost per kilowatt capacity will probably go on decreasing up to an output of, say, 30,000 KW. normal, but after that it will probably rise.

When considered from the operating side it would appear that the limit is certainly not above 30,000 kilowatts, but, in all but a few stations, much below it. The maximum load should be carried by either two or three running sets, with two extra sets, one under overhaul or repair and one spare. If the maximum demand is such that this principle would require the installation of sets of the maximum economical size (30,000 KW.), then any increase in demand would be met by the installation of further units of this size. It would appear that the maximum number of large sets in a station should not exceed eight, carrying a load of 180,000 KW. If two such stations were comparatively close together and could be linked, a larger turbine might be justified.

The 30,000-KW. turbines would run at 1,500 revolutions per minute, and whilst a station with eight of these machines would be more economical, it would not have much financial or thermal advantage over a station containing eight sets each of 10,000 KW., which would run at 3,000 revolutions.

4.—Drive of Auxiliaries.

In determining the method adopted for driving the various station auxiliaries, the points to be considered are:—

1. The main turbines must not start non-condensing, and
2. Each main unit should be self-contained as far as possible and not dependent upon any other plant for its continuity of running.

Examining the alternatives from the thermal efficiency standpoint, steam drive throughout appears advantageous provided that all the exhausts can be led to a feed heater, but there is one objection. Many of the units are small, and the auxiliaries, engines, or turbines could not efficiently utilise the high pressure and highly superheated steam used for the main set.

The thermal efficiency of the small turbines or engines is, therefore, very low compared with the main turbine, and the same steam would probably generate double the power in the main turbine. However, whilst high thermal efficiency is desirable, no method must be adopted which causes the main turbine to be started non-condensing.

An all-electric drive appears to be necessary from the point of view of efficiency in a modern high-pressure station, but power derived from the main set will not allow the set to start up condensing, as no power is available until it is up to speed. Separate condensing turbo-generators are quite satisfactory, and if exhausting into a feed heater are highly efficient.

With a 25,000-KW. main set a 1,000-KW. auxiliary set would provide all the power required unless there was a large demand for a cooling tower. If the small set exhausted at, say, 5 lb. per sq. in. gauge into a surface feed-heater through which the condensate from the main set was passed as circulating water, the heat available would probably be sufficient to raise its temperature by about 90 deg. to 100 deg., and thus reduce the number of tappings required on the main turbine. Thermally this is the most efficient method of generating the auxiliary power, as by this means it is generated without rejecting any latent heat to the circulating water system. The cost of the plant is quite reasonable, and the saving in fuel considerable.

5.—Maintenance of Efficiency.

Whilst the manufacturer usually thinks of the steam consumption guarantees as demonstrated (or not) on the official test, the purchaser's interest is more lasting. It is the considered opinion of turbine builders that, as they cannot control the handling and operation of the machine after it has been taken over, they cannot be responsible for the steam consumption after that time. If called upon to give a guarantee of steam consumption during or at the end of the maintenance period certain stipulations are made, but the turbine builder endeavours to use such materials for the blades and nozzles as will withstand the scouring action of the steam for the maximum period. With this object in view many series of experiments have been made, and more are now being initiated to ascertain the most suitable material. It is proposed to insert blades made of various materials in turbines that have given trouble owing to blade erosion or corrosion and observe their condition from time to time. The materials being so tried include monel metal, phosphor bronze, mild steel, 3 per cent. nickel steel and stainless steel, &c. In these cases the makers of the material are supplying it for the test free of charge.

Generally speaking, erosion does not commence until the steam has lost its superheat and becomes wet, although corrosion due to acids in the steam will occur at any part of the blade system. Erosion will naturally be greater the higher the steam velocity, and, therefore, the greater the heat drop per stage. Some deterioration in efficiency is bound to take place, but the extent of it is dependent upon the design. For moderate steam velocities and low-stressed blades standard 70/30 turbine bronze is very satisfactory, and for higher stresses and velocities a 3 per cent. nickel steel is used very largely and with success. The maintenance of efficiency is mainly dependent upon the condition of the blades, but there are other factors affecting it in a minor degree. If the shaft whips, the gland and diaphragm clearances, or in reaction turbines the tip clearances, will be increased, with an increase in steam consumption.

6.—Condensing Plant.

The whole art of condensing plant design as it is now known owes its existence to the turbine. In the old engine days a 26-in. vacuum was all that an engine could really use, and in fact the author knows of a case where an exhaust control valve was fitted between engine and condenser to prevent too great a vacuum getting into the cylinder. With the development of the turbine the advantages of higher vacua were at once apparent, and condensers became more than the box of tubes which they had been considered.

A good design of condenser allows the steam to spread over the whole length of tubes easily; reduces the drop in pressure from steam inlet to air pump suction to a minimum; works on the counter-current principle; and concentrates the cooled air at the air pump suction, the degree of cooling depending upon the relative sizes of the air pump and the condenser for their respective functions.

All condensers are now based upon the counter-current principle, and the chief differences between various designs are the arrangement of baffles and guides which distribute the steam over the cooling surfaces and lead the condensate and air to their respective exits. Purchasers have different ideas as to the merits of a comparatively large surface and a small quantity of circulating water or a smaller surface and more water. The former combination increases the cost of the plant, but reduces operation costs, and the latter acts in the reverse direction. It is usually better to reduce operating costs at the expense of increased capital charges, particularly with the greater load factors under which the large sets in a power station now run.

The rotary air pump has been developed almost entirely within the last 12 to 14 years. There are many forms in use at the present time, all using either a water jet or a combination of a water and steam jet. The chief claim made for all types using a steam jet is that all the energy in the steam used for the jet is conserved to the system, that not used for doing the actual work of discharging the air drawn from the condenser against a higher pressure being absorbed either direct in the condensate or in a surface feed-water heater. The same thermal claim has been made regarding the power used to circulate the water through the water jet, but the desire to reduce the number of working parts led engineers to devise means of doing away with this water jet.

As a result the steam jet ejector has been developed, and is now in general use. These are always of the compound type, having two sets of steam jets operating in series, but in one arrangement there is an intermediate heater fitted between the two sets of jets. This results in a considerable saving of operating steam. Thus assuming that in the first jet five volumes of steam are required to remove one volume of air, the total volume to be removed in the second jet without intermediate condensation would be six, and sufficient steam would have to be supplied to handle this volume. When intermediate condensation is used, the volume delivered to the second jet is reduced by the elimination of the steam used in the first jet with a resulting saving of steam in the second jet. As with rotary air pumps using a steam jet, the heat in the steam used in the jets can be recovered by passing the condensate from the main condenser through the intermediate heater and also through another heater for the steam from the second jet.

The use of a surface heater for this purpose is preferable to leading the steam from the ejector into an open tank containing the condensate, as the latter method causes the condensate to become saturated with air.

In all cases where steam is used direct for air-extracting purposes and the energy remaining in the steam absorbed as heat in the condensate, there is one important point which should not be overlooked. Owing to the fact that the boiler efficiency is below 100 per cent., the raising of any steam always involves certain boiler losses, which are expressed in increased fuel consumption and are not recovered in condensing the jet steam in the condensate.

The same argument may be used against steam-driven auxiliaries and in favour of electric driving throughout.

7.—Feed-water System.

A development which is coming very much to the front at the present is the "closed" feed-water system to prevent the condensate absorbing air en route from the condenser to the boiler. If steam could be obtained free from air, and no leakage occurred, no air pump would be required. If air were then admitted even in small quantities the condenser would eventually become air-drowned, and no vacuum would be obtained. An air pump of a certain capacity is fitted with the object of abstracting air at the rate it is entering the condenser. If the volumetric capacity of the air extractor remains

constant, any alteration in the amount of air entering the condenser causes a corresponding alteration in the density of the air, so that the volume abstracted remains constant, with a resulting alteration in vacuum. If, therefore, the amount of air entering the system can be reduced an increase of vacuum will follow with the same air extractor and circulating water. Leakage of air at the turbine glands should be now practically non-existent, and the air in the system has been reduced to that entering the boiler with the feed water. The condensate as it leaves the condenser contains the minimum possible amount of air, and should be passed through a closed meter, if one is required, and a surface feed-water heater, instead of being passed over a weir for measurement, and heated by means of special nozzles introducing exhaust steam below the water level in heating tanks. It can be discharged either direct to the feed pump suction or, if some flexibility is required, the extraction pump could discharge into a header with small connecting pipes to a surge tank, the feed pumps drawing from the same header. Whilst this may allow some air to be absorbed by the condensate it would be a great improvement over the usual open hotwell.

The make-up feed water should be deaërated, and the method adopted depends on the quality of the water. If good, it may be introduced into the bottom of the condenser, cooling the air pump suction. It is then deaërated with the condensate. Or it may be passed through a special surface heater and be heated by some auxiliary exhaust steam if available.

If it is of poor quality it should be passed through an evaporator and a condenser, and the pure water then introduced in either of the above ways, this method being preferable to the use of any chemical water-purifying plant owing to the attention constantly required to adjust the reagents to the water quality.

8.—Guarantees and Testing.

On account of the present high cost of coal and the higher load factor always given to the latest and most economical turbine in any power station, many, if not most, of the contracts for large turbo-alternators are placed on steam consumption guarantees. The basis on which such guarantees are given and the method of testing them are matters of great importance, and often of financial importance to both parties to the contract. One basis of guarantees which has been adopted occasionally, but which is not satisfactory, is for the purchaser to specify a consumption under given conditions and state that he will pay a bonus for all reductions below this figure. The normal method of the contractor stating his consumption with a penalty or bonus should this figure, plus or minus a margin of 2.5 per cent., be exceeded or improved, is the standard, and is quite satisfactory.

As a turbine is designed for the most economical output, and other loads cannot receive the same consideration from the designer, the guarantees should be given only on the most economical load, or if other load guarantees are required, the same importance should not attach to them as to the most economical load. A true mean load guarantee meets this point and is calculated as the average of the following :—

Consumption at 25 per cent. overload × 3.
Consumption at full load (most economical load) × 4.
Consumption at ¾ load × 3.
Consumption at ½ load × 2.

With larger sets the half-load is not so important, and may be omitted. The multiplying factors may be varied to suit the prevailing load conditions obtaining in any power station.

As to the amount of the penalty, turbine builders are very loth to accept a penalty which would fully compensate a purchaser for any excess steam consumption, but are usually prepared to accept a reasonable penalty provided that a bonus is also offered.

Penalty and bonus are reminders of the early days when the art of turbine design had not advanced to its present standard, and steam consumption guarantees, although given in good faith, would not be always obtained on test. There is now only a very remote chance that either penalty or bonus will be payable in connection with a contract placed upon competitive tenders from responsible manufacturers.

As to the method of testing, there are many different opinions particularly regarding the duration of the test. The chief difficulty with large sets is to provide a steady station load, as a water load cannot be considered. Once a steady load and steam conditions are obtained an hour is quite sufficient.

One point regarding consumption tests which causes some discussion is the difficulty experienced in such stations in reproducing for the test the steam conditions for which the turbine was ordered. Turbine builders now ask that the margin of 2½ per cent. be increased by an amount equal to one-quarter of the total corrections, irrespective of direction, in excess of 5 per cent.

9.—Overall Thermal Efficiency of Power Station.

For all stations it is possible to obtain a Willans line connecting fuel consumption and units generated per day.* This allows the fuel or heat consumption to be calculated for all daily load factors, and the actual consumption should be checked against this regularly. On account of the varying calorific value of different fuels, it is far better to refer to heat units per unit generated than to lb. of coal. Mr. Samuel Insull has stated that when the daily records from the Chicago stations show a heat consumption exceeding 20,000 British thermal units per unit generated he begins to inquire what has gone wrong. In a modern power station with a daily load factor of 40 per cent. to 50 per cent. this figure is probably a good lead.

* See Electrical Review, February 21st, 1919. Article by Mr. R. H. Parsons.

10.—Conclusions.

Reviewing the various points touched upon in this paper dealing with the improvement of the thermal efficiency of a large power station, the following conclusions seem to be reached :—

1. That steam pressures of 350 lb. per sq. in. (gauge) and total steam temperatures of 700 deg. F. are quite suitable, and that these figures may soon be raised to 500 lb. and 750 deg. F.
2. That vacua should be as high as possible, the vacuum temperature being about 21 deg. F. above the water temperature at 80 deg. and about 26 deg. F. above if the water temperature be reduced to 55 deg. F.
3. That heating the condensate by the use of steam tapped from the main turbine is desirable, and that the heating can, under certain conditions, be carried with advantage up to a temperature of 300 deg. F. by exhaust steam from auxiliaries where available.
4. That reheating of the steam after partial expansion in the turbine does not promise an adequate return.
5. That the manufacturer could, if called upon, design and construct turbines and alternators for any size up to 100,000 KW., but at a very great expense.
6. That the economical limit in size with a vacuum of 29 in. and leaving losses limited to 2½ per cent. is probably about 30,000 KW., which would run at 1,500 R.P.M.
7. That auxiliaries should be electrically driven, the power being obtained from an auxiliary turbine exhausting into a feed heater.
8. That in comparing air-extracting systems due consideration must be given to the boiler losses incurred in raising steam used in connection therewith.
9. That a closed feed-water system should be adopted.
10. That overall consumptions be exprsesed in British thermal units per unit generated and not in lb. of coal.
11. That a maximum consumption of 20,000 B.TH.U. per unit generated be the objective in large stations.

Discussion.

Mr. Roles, introducing the subject, referred to negotiations with the B.E.A.M.A., which had taken place during the year, and said that Mr. Robinson would put forward the manufacturers' side of the question; he hoped the members would give the users' side, and thus help to smooth away any difficulties that might exist.

Mr. Robinson explained that the paper was the outcome of an invitation from the I.M.E.A. to the B.E.A.M.A. to provide a paper on the subject from the manufacturers' point of view; a questionnaire was addressed to all members of the latter Association who made turbine plant, and the paper represented the substance of the replies, though there was much matter which he had not been able to use. The paper, therefore, did not represent his own views. He noticed that an article had appeared in the *General Electric Review* * describing a large power station, and that in many of its features the conclusions reached were identical with those appended to his paper.

Mr. A. Q. Carnegie (of Messrs C. A. Parsons & Co., Ltd.) said the new power station of the Newcastle-upon-Tyne Electric Supply Co., Ltd., at Carville, had now been running at an inlet temperature of about 700 deg. F. for about four years. The increased temperature was found to produce certain strains on the blading, due to expansion effects brought about by change of load, but the further sub-division of the shrouding strips on the blade tips completely got over this trouble. Their research department at Heaton works had carried out a very complete investigation on the behaviour of different metals for blades under the actual conditions of temperature met with in steam turbines. One of the simplest tests for a blading material was that given by the "Sankey" machine (an alternating bend test in which the material was stressed beyond its elastic limit in alternate directions until fracture occurred). A heavy heating current was passed through the specimen to maintain it at the desired temperature, which was measured with a thermo couple. "Sankey" tests showed that a number of materials were suitable for blade making, whose strength and toughness at turbine temperatures were perfectly satisfactory, even above 750 deg. F. The best of these materials were manganese copper containing 3 to 4 per cent. of manganese, certain cupro-nickels, mild and 3 per cent. nickel steel, and monel metal; 70/30 brass was suitable only for the lower temperatures. Steel blades had the advantage of great strength, but were liable to corrosion and erosion to a much greater extent than some of the non-ferrous metals; monel metal had the strength of steel without being corrodible. Blade deterioration did not occur in reaction turbines except to a very slight extent at the exhaust end, and even then it took place at the back of the blade, where it had no effect whatever on the efficiency of

* See Electrical Review, June 18th.

the turbine. Manufacturers of reaction turbines took the greatest interest and pride in the steam consumption of their machines long after the official tests had been completed. If would be a very good thing if station engineers would repeat the official test, say once every year. The 10,000-kw., 2,400-r.p.m. Parsons turbo-alternators at work at the Carville power station were all built during the war; the first one was put into service in 1916, but it was not possible to carry out any official tests until November, 1919, the second machine installed being the first one to be tested. This machine (B2) had run from May, 1917, until November, 1919, a period of 2½

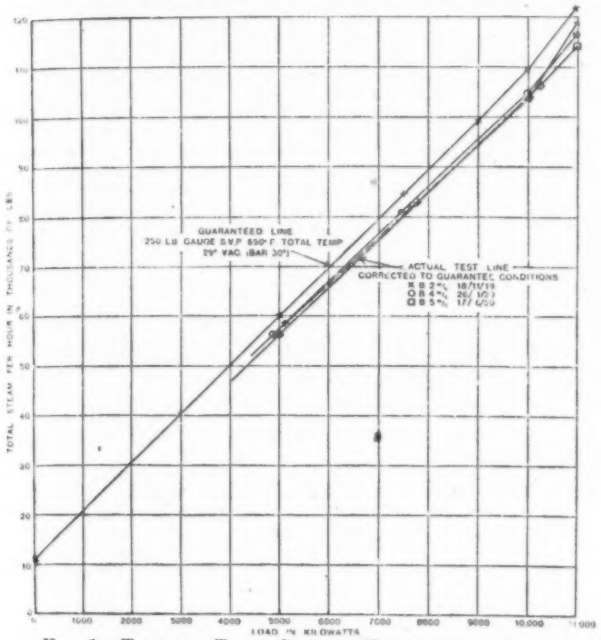

GUARANTEED LINE
250 LB GAUGE S.V.P. 650° F. TOTAL TEMP.
29" VAC. (BAR 30")
ACTUAL TEST LINE
CORRECTED TO GUARANTEE CONDITIONS
LOAD IN KILOWATTS

Fig. 1.—Tests on Three Parsons Turbo-alternators of 10,000 kw., 2,400 r.p.m., at Carville Power Station.

years. Tests had also been carried out on machines Nos. B4 and B5, B4 having been at work three months and B5 one month before their respective tests. The results of these tests, which were carried out by the testing staff of the Newcastle Electric Supply Co., were shown in the diagram, fig. 1, the upper line being the guaranteed figures under contract conditions, and the lower lines being the actual results obtained on the three machines tested. The test results lay so closely together that without referring to the distinguishing marks it was almost impossible to realise that three tests were shown. These figures showed remarkable

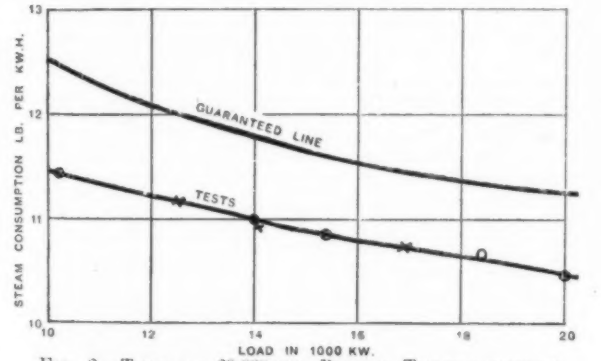


Fig. 2.—Tests on 20,000-kw. Parsons Turbo-alternator at Chicago.

conformity of results, and clearly demonstrated that a good result with a reaction turbine was not due to chance. They also showed that the newest machine had no advantage over the machine which had done 2½ years' work, and that, therefore, no deterioration in efficiency had taken place during this time. The first machine installed (B1), which had been running 3½ years, had still to be tested, as had also B3, which had been running about 12 months, and he had absolutely no doubt but that the steam consumption points of these two machines would squeeze themselves modestly into line with those of the three machines shown on the diagram. The steam conditions usually obtaining at Carville were 250 lb. stop-valve pressure, 680/700 deg. F. temperature, and 29/29.1 in. vacuum, the actual steam consumption at full load being between 9.9 and 10 lb. per kilowatt-hour. The Carville turbines did not by any means represent the best that could now be done by machines at their capacity and speed. A 25,000-kw. turbo-alternator was supplied by his company to the Fisk Street power station of the Commonwealth Edison Co. at Chicago in 1914; the diagram, fig. 2, showed the results of tests made in June, 1914, as well as in March, 1918. The figures lay quite snugly along the line, and a further test had been made within the last few months with the same result. British engineers would be proud to hear that this machine had proved the salvation of the power station at a time when certain American turbines had been playing at the unpleasant game of "letting go." The use of fine tip clearances was avoided in modern reaction turbines by the adoption of "end-tightened blading." The radial clearance with this blading could be made as large as desired, the usual figure being 3/16 to ¼ in. Fig. 3 showed a turbine cylinder and shaft partially bladed; the blade bases, instead of being made flush with the surfaces of the cylinder and spindle, were

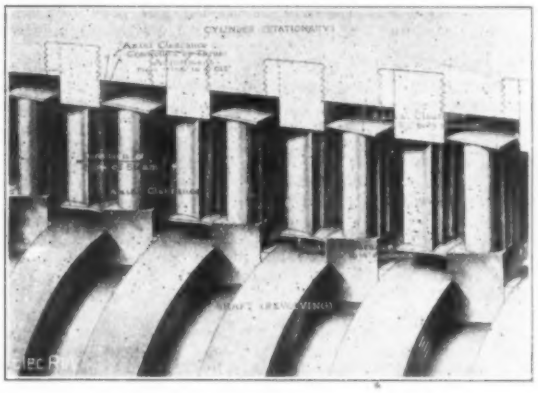


Fig. 3.—Parsons "End-tightened" Blading.

extended up so as to form a continuous barrier, against which the shrouding on the blade tips could bear. The edge of the shrouding was thinned away to a fine edge, so as to reduce the rubbing surface to a minimum, and the whole of the shrouds were ground up into intimate contact with the projecting barriers, with the turbine at as near its working temperature as possible. After grinding up, the shaft was lined off to a suitably fine running clearance, by fitting liners behind the thrust bearing. Figs. 4 and 5 showed a group of end-tightened blades with serrated caulking pieces ready for insertion into the groove. The caulking piece was inserted

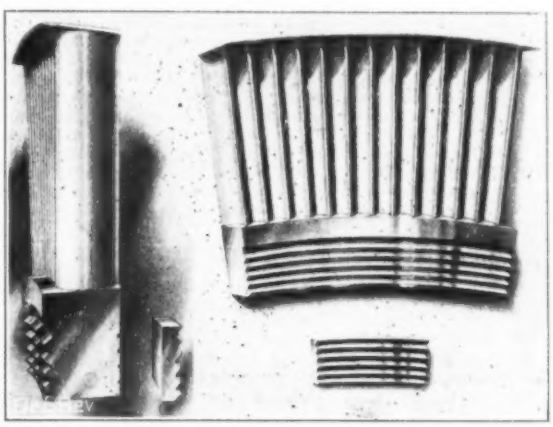


Fig. 4.—Side View. Fig. 5.—Front View.
Figs. 4 and 5.—Blade Unit Assembled, Brazed Solid at Roots and Serrated; and Locking Piece.

at the end of the group, and driven into position in a circumferential direction; the serrations in the spindle grooves were thus filled quite independently of the caulking, and the slight buckling of the caulking piece when driven up circumferentially, set up a very powerful side component or toggling action, which ensured a perfect lock, and was practically independent of delicate workmanship. The turbine shaft was maintained in position in an axial direction by means of its adjustable thrust bearing, which was of the pivoted-pad type, and the shrouds on the blade tips could be adjusted to run with safety with an axial clearance ranging from 8 to 15 thousandths of an inch, depending on the size of the turbine. Even in the case of careless handling, which might possibly cause the projecting portion of the shroud to be ground away so as to destroy the efficiency of the packing,

the old shroud could be easily removed and replaced by a new one with but little loss of running time.

Mr. W. M. SELVEY said that the author's explanation of the origin of the paper disarmed criticism; with most of the points put forward he was more or less in agreement. None of the results given in the paper showed an advance on those obtained ten years ago; the suggested standard of 20,000 B.TH.U. per unit was reached a long time ago. Very great advances had been made in the generation of electricity because power stations were getting loads which enabled them to use plant of high efficiency. He agreed that no great benefit was to be derived from interheating. There was no necessity to incur great expense on experimental plant, as the results could be closely foretold by calculation. He agreed that sets of 100,000 KW. need not be considered; 30,000 to 35,000 KW. was quite big enough. With regard to the materials for blading, much money might be wasted on unnecessary experiments; the materials in the boiler water were more important—foreign matter was the cause of blade erosion. The blades would be all right if they used clean water. The same was true of corrosion. He had met with only two examples of unsuitable materials for blades, and it was unnecessary to use these fancy metals; mild steel was quite suitable. They could not get all or even most of the air out of the water by the use of a closed-feed system, and it was unnecessary to waste money on it. With regard to the margins of 2½ per cent. and 5 per cent. in testing, he saw no reason for them; if they had to have margins of 3 or 4 per cent., tests were useless—they could calculate the efficiency from the design nearer than that. He heartily endorsed Mr. Carnegie's figures, the result of tests carried out by Mr. Fawsett; the accuracy of the tests showed that there was no need for a margin. With regard to the 20,000 B.TH.U., which represented 17 per cent. efficiency, he said that 17,500 was in sight; but were they to waste 80 per cent. of the heat energy for all time? They should look forward to utilising that 80 per cent.; he had shown that low-grade heat was applicable to many purposes. Engineers were working "too close to their job." There should be a public utility engineer to control the use of fuel for all purposes in an area, and responsible for getting the maximum value out of it—then they would get results.

Mr. LAWSON (Cole, Marchent & Morley) asked if it was possible to get perfect instruments.

Mr. SELVEY, referring to his I.E.E. paper of 1914, said that he there showed how to secure an accuracy within 1 per cent. The instruments used were specially designed for accuracy.

Dr. S. Z. DE FERRANTI said that the paper went to the root of electricity supply, dealing as it did with the all-important question of efficiency. He referred to Lord Moulton's misleading statements with regard to the relative values of gas and electricity, and said that visions had a way of coming true, and stimulated others to work on lines leading to success and to the benefit of the community; ten years ago, in his I.E.E. presidential address, he had outlined the "all-electric" idea. With regard to the efficiency of power stations, he referred to the valuable and stimulating papers by Mr. Shaw and Mr. Selvey before the I.E.E., and said that with a few exceptions he agreed with Mr. Robinson on the technical facts. Improvement could be effected in three ways: by increase of working temperature, by recuperating low-temperature heat, and by increase in size of plant. The boiler house was largely responsible for failure to realise in normal working the excellent results obtained on test. They should endeavour to maintain the efficiency of boilers irrespective of the time they had been in use, and the boilers and furnaces should be so designed that the stand-by losses were avoided. With higher steam pressures, the plant would be more costly to install and maintain. The best pressure was 500 lb. per sq. in. The system of "bleeding" the turbine to heat the feed-water was very attractive, and saved 5 per cent. on paper, but it was disappointing in reality. But progressive feed heating effected a real thermal saving. He went into this fully in 1906. Degradation of temperature was fatal to economy, but progressive feed heating avoided degradation. The condensate was taken from the hot well and progressively heated by taking steam from different points of the turbine. The system had a high theoretical efficiency, and was being tried on two 20,000-KW. turbines on the North-East Coast. With the same turbines resuperheat was to be used on the lines which he applied long ago to a Vickers turbine. He believed that no saving was too trivial to be taken into account if they were going to supply electricity cheaply. As the result of a great many experiments during the past 15 years they would soon have stations which would return on the switchboard 28 per cent. or more of the energy in the fuel. There was no fundamental difficulty in realising that result commercially. Electricity would succeed on its own merits—nothing could stop it; legislation was needed to put the electrical industry in order, and everything should be done along lines which would fit in with the use of electricity for everything. In his presidential address he had postulated a thermal efficiency of 25 per cent.; they were going rapidly in that direction, and had not reached a limit. Efficiencies would go up, and these visions would be realised. By obtaining this paper the Association had done the industry a great service.

Mr. G. WILKINSON (Harrogate) said they had either to cheapen production or to raise the price of electricity. They ought to use part of that wasted 80 per cent. (of which they ought to be ashamed). As a solution of the difficulty he advocated the introduction into steam turbine stations of some form of internal combustion engine, which would effect an improvement of 10 to 15 per cent., and would materially change the commercial aspect of the question. The internal-combustion engine, it was true, was not yet made in large sizes, but the Germans had used oil engines up to 400 H.P. per cylinder; with three cylinders acting on one crank, and six cranks, they would get 7,200 H.P. in one set. Such engines forming up to 25 or 30 per cent. of the plant would provide sufficient boiling water for the boilers. The economiser was getting out of date; it was the weak spot in the boiler house, and if placed above the boilers was a source of danger to the stokers, besides adding to the cost of the buildings. Substituting a hot-air economiser, they would increase the boiler efficiency, and burn 50 or 100 per cent. more fuel efficiently, with mechanical draught, while a smaller boiler capacity would suffice. The condensing plant would be smaller and cheaper, less condensing water would be required, and the cost of electricity would be reduced, thus helping the country to make a rapid economic recovery.

Mr. SWALLOW (Messrs Richardsons, Westgarth & Co.) described the paper as a classic. With regard to the condensing plant, he agreed that electric driving was preferable for the auxiliaries, on the score of reliability and economy. In large installations his firm preferred to divide the pumping plant into two sections, each capable of dealing with the whole of the load. If a steam ejector were used in series with a water ejector, the combination used only three-quarters the steam required by a two-jet steam pump, producing a 28-in. vacuum. The use of evaporators to provide pure water was not as widely adopted in this country as it should be; where hard water was used there was continual boiler trouble, but by installing evaporators that trouble was done away with. The exhaust from the feed pumps could be used for heating the evaporators.

Mr. F. AYTON (Ipswich) referred to the importance of preventing the corrosion of turbine blading; it was his experience that the corrosion took place when the turbine was standing, and could be stopped by removing the water vapour from the turbine casing by means of a daught of air. He doubted whether Mr. Wilkinson could burn more coal of the quality now available, on any grate; where efficiency was wanted was at the coal pit—in cleaning the coal. An interesting report on the subject of power station design was submitted at the N.E.L.A. Convention last month; it was stated that pressures up to 1,000 lb. per sq. in., and a maximum temperature of 800 deg. F., were contemplated, but at present 300 lb. pressure and 700 deg. might be taken as the practical limits, and would require a high degree of operating skill. Smaller stations would not exceed 250 lb. and 600 deg. for some time to come. Real operating difficulties had been met with in connection with valves and fittings in the neighbourhood of 300 lb. pressure. The serious turbine breakdowns in America had all been in connection with the impulse type. The initial cause was whipping of the shaft, causing rubbing and heating, which increased the distortion. United States manufacturers had, therefore, changed the method of packing the diaphragms, putting the teeth on the shaft instead of on the diaphragm, and thus reducing the tendency to heating the shaft in case of contact.

Mr. LEA (Lea Recorder Co.), referring to the author's objection to passing the condensate over a weir, said that there was great diversity of opinion as to the cause of corrosion, which had been known to take place where pure water was used, without a weir. He denied that falling over a weir appreciably aerated the water, but held that a great deal of air was absorbed in the open hot well. The condensate was not so pure as it was supposed to be, and the weir notch only added 2.5 per cent. to the air present in the water in the hot well.

Mr. P. V. HUNTER emphasised the importance of small gains in efficiency, to which Dr. Ferranti had drawn attention. Nowadays load factors were high, and engineers ran their newest and most efficient plant on full load as many hours as possible; the station load factor had no bearing on that of the new plant, which was very high. The maximum thermal efficiency attainable if all the plant had no losses was 35 or 36 per cent., but in practice only half that value was realised; hence a very small improvement in running efficiency was important, apart from changes in design. How could the low-temperature heat, now thrown away, be utilised? Possibly it could be employed to stimulate the growth of plants. It was common knowledge that a station designed on Dr. Ferranti's lines was being erected on the North-East Coast, using a pressure of 500 lb. and a temperature of 700 deg. F. The steam would be reheated in two stages, and the condensate in three. The station was designed for a thermal efficiency of 24½ per cent., and there was little doubt that that figure would be attained. But it was only worth while with a station load factor of 80 per cent., owing to the cost of installation and attendance.

Mr. ROBINSON, replying to the discussion, said that a special committee of the B.E.A.M.A. was considering the materials for blading, and trial blades were to be fitted in certain turbines that had given trouble. He had not suggested the total elimination of air from the feed water; the condensate contained the minimum amount of air, and the

closed feed system was intended to exclude additional air. He agreed with Mr. Selvey that tests could be carried out with an accuracy within 2½ per cent., but in many stations the specified steam conditions could not be realised, and the necessary corrections sometimes amounted to 20 per cent.; if, then, the result fell 2 per cent. short of the guarantee the manufacturer was penalised! Hence the necessity of a margin. Progressive feed heating with small differences of temperature was the most economical method, but could not be fully carried out; he suggested four stages for a pressure of 300 lb. He did not favour the idea of an internal combustion engine with 18 cylinders. He agreed that evaporators were desirable, but was not convinced that weirs did not aerate the condensate. He doubted whether the gain due to bleeding turbines would compensate for the increased complication, and pointed out that reheating entailed losses. In conclusion, he expressed the desire of the B.E.A.M.A. to help the I.M.E.A. on the path of progress, and suggested that the Convention should be expanded to include all branches of the industry.

Mr. Roles, referring to the advisability of seeing questions from both sides, said he had long thought that they might be more catholic in admitting other branches of the electricity supply industry to the Convention.

IMPROVEMENTS IN MOTOR-CARS: ELECTRIC LIGHTING AND STARTING.

By F. H. HUTTON.

The opinions expressed on this subject in the *Times* of May 15th, while interesting, can hardly pass unchallenged; probably they were not expected to do so. The writer of the article in question, apparently in all sincerity, puts forward the view that, because of the inexperience in electrical matters of the average motor-owner and the consequent apparent complication of the necessary apparatus, progress in this direction should be stopped, and a return should be made to paraffin and acetylene lamps and to the low-tension magneto. From the same point of view would he recommend, because the practice of wireless telegraphy necessitates a grasp of electrical matters and some study of the science by those who use it and have charge of the really complicated apparatus involved, that we should revert to the heliograph and semaphore? Undoubtedly in the latter cases the desired simplification is retained. Simplification in numberless other directions can be obtained by following out the same principles to their logical conclusion. If this idea were carried out as regards electric lighting and starting on cars in this country the natural result would be that other nations would progress while we receded, for there is no standing still in such matters—it is a case of going ahead or astern. The magneto industry itself furnishes an example of the danger of allowing other nations to acquire knowledge and experience of manufacturing scientific apparatus while we go to sleep, for at the beginning of the war the experience of magneto manufacture in this country was practically nil, and it is to the everlasting credit of a few energetic firms that the enormous difficulties of initiating such an industry in wartime were overcome.

The writer of the article truly remarks that it is self-evident that at the present moment electric light is the most popular illumination system for motor cars, and that its superficial advantages are too patent to admit of argument; he contends, however, that the cost is too high, and that although the average motor-owner has acquired enough knowledge and experience to look after such things as valves, magneto, carburetter, &c., he "fears and mistrusts electric light and engine starters." Why the magneto should be placed among permissible apparatus while dynamos and motors are on the black list is not easy to understand, since many more intricate problems are bound up in the former than in the latter. It is presumably a case of familiarity breeding confidence, and it is just this argument that it is wished to bring forward with regard to other electrical apparatus on cars. The civilised world is becoming more "electrified" every day; knowledge of electrical engineering is increasing on all sides and among all classes; electricity is used for lighting wherever a supply can be obtained; for the purpose of applying power to industry and domestic needs it is unrivalled; even for heating purposes, where the cost compares unfavourably with other methods, there is an insistent demand for it owing to the convenience and cleanliness which in the long run often outbalance the extra cost. With all this increasing knowledge of electrical engineering it will surely come about that the average motor-owner will soon acquire enough familiarity with the subject to look after his electric lighting and starting system, especially when he has become aware of the enormous convenience which such systems confer. For it is not only in connection with lighting and starting that electricity is found useful on a car. It is the most convenient means of sounding a horn; it is by far the most adaptable method of warming the carburetter, and so allowing the use of inferior fuels; it is invaluable for an inspection lamp; it warms the driver's gloves and the passenger's foot-muff; pumps the tires; and it is ideal for heating the vulcaniser. Since all these advantages in addition to the benefits of all lights, both exterior and interior, and engine-starting are to be obtained for the small amount of mental exertion necessary to understand the elements of electricity, how many people would wish to return to the miseries of fitful and inefficient paraffin and acetylene lamps?

On the argument of cost we have only to look across the Atlantic, to the land of democratic motoring and cheap cars, where there is one motor vehicle to every 14 inhabitants. In that country it would be about as easy now to sell a car without an electric lighting and starting system as a horse with only three legs, and, as a matter of fact, ever since the year 1917 over 99 per cent. of the cars have been so fitted. Even the humble Ford has had to follow suit.

As regards reliability and the amount of attention required for electrical systems, the following extract from the Electrical Review, giving the experience of a private owner in this country, may be of interest. "In 1915 I purchased an American car fitted with electric lighting and an electric starter by secondary cells charged from a dynamo which could also be used as a motor. This equipment has given me complete satisfaction over a period of nearly five years. Energy is provided for starting the engine from cold even in winter, for lighting seven lamps, for firing the engine, and for actuating the horn. Up to date the car has run some 9,000 miles, mostly on short journeys, and the engine has never once been started by hand. The small mileage is due, of course, to the war, but the short journeys have meant very frequent engine starting and a consequent heavy tax on the batteries, but the three cells have stood up to the work, and have not so far required any attention other than a little distilled water once a month."

One wonders what this owner of a five-year-old car would remark if he were advised to go back to a car with paraffin side and tail lamps, with acetylene headlights, and with low-tension magneto ignition!

Japanese Trade with India.—A correspondent of *The Times Trade Supplement* states that Japanese competition in the Indian market seems likely to prove more serious than is generally realised. "So far as it has taken place at present it bears the appearance of being part of a studied plan, an essential feature of which seems to be to lull British traders into the feeling that Japanese goods will always be of the cheap showy type for the bazaar trade, whilst at the same time a sound footing is being obtained for future business in heavy electrical plant, rubber and chemical goods, cutlery and heavy metal products. . . .

"Apart from the textile trade, regarding which such strenuous efforts are being made by Japan, the principal inroads into Indian trade by that country will be in connection with electric cables and accessories, plant and machinery, hardware, paper, cutlery, paints, chemicals, and haberdashery."

A PROPOSED IMPERIAL WIRELESS CHAIN.

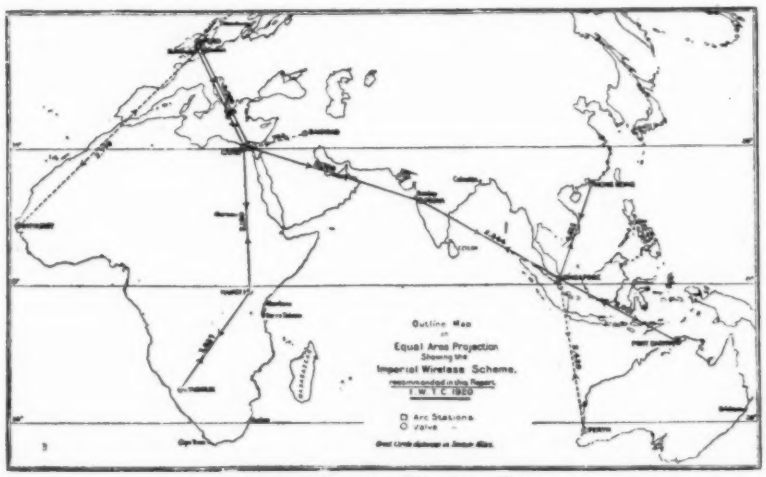
The Committee's Report.

THE IMPERIAL WIRELESS COMMITTEE, of which Sir Henry Norman was chairman, and which was appointed to prepare a complete scheme of Imperial wireless communication, issued its report last week (Cmd. 777. Price 6d. net).

The War Office presented to the committee a scheme calling for the construction of 22 main stations and 23 subsidiary stations, the total capital cost of which would be many millions of pounds. The committee is of the opinion that the chief military and air force needs will be met by the scheme necessary for commercial requirements, and adopted the principle that if one of the fighting services should hereafter require subsidiary communication with a locality where little or no commercial need exists, or is likely to arise, the station in such locality would be erected and maintained at the cost of the service requiring it. It would be unreasonable to handicap a commercial Imperial scheme with the cost of purely military needs of any kind.

In summary form, the conclusions reached by the Committee are as follows:—

Proposals for an Imperial wireless chain usually contemplate links of about 4,000 miles each—the distances, for instance, between England and India, and between India and Australia. For these distances all spark systems are obsolete, and the high-frequency alternator in its present state of development is costly, difficult to repair, and as yet insufficiently tested in prolonged operation. Therefore the arc system, the most widely used to-day for long-distance wireless communication, would have to be adopted. It is, however, impossible to say beforehand what power would be required at such ranges for a satisfactory commercial wireless service, which the Committee defines as a 24-hours a day service, not subject to frequent interruptions and repetitions, reliable, working at high speed, and of a capital cost and annual expenditure such that at rates low enough to attract a large traffic it might speedily become self-supporting.



PROPOSED IMPERIAL WIRELESS CHAIN.

No satisfactory commercial service, as thus defined, over even half the above range, is in existence anywhere at the present time.

The cost of a pair of stations in England and India, equipped in about two years with the smallest arcs likely to effect this communication, would be £615,000, and the annual charges £155,000. Yet no certainty could be felt that this power would be adequate, since no such arc is working efficiently anywhere to-day under conditions enabling its efficiency to be judged, and it would be unwise to incur the cost of the larger arcs until acquainted with the results of the working of an arc of greater power than any hitherto constructed, shortly to be in operation by the French Government.* Moreover, the possibility that the arc system is obsolescent must not be overlooked. The Committee concludes, therefore, that an Imperial wireless chain of 4,000-mile links bridged by arc transmission is, alike on technical and economic grounds, for the present inexpedient, and seeks another solution of the problem.

This is found in the two complemental facts that the chief countries of the Empire can be connected, both commercially and strategically, by links of about 2,000 miles, and that the advance of wireless science has rendered it possible to produce wireless power sufficient for this range by the employment of thermionic valves. The current thus generated admits of the sharpest tuning, allowing the use of a large number of contiguous wave-lengths, and it is particularly suitable for high-speed working. Important experiments in the design and construction of valves have been carried out at the Naval Signal School at Portsmouth, in high-speed signalling by the use of valves at the Army Signals Experimental Establishment at Woolwich, and at the Post Office. The valve system is undoubtedly in the line of future development of wireless telegraphy, and it promises to cost less than the arc system to install and operate.

A Post Office wireless service by arcs, sanctioned by the Cabinet last year, will shortly be in operation between England and Egypt. In the Committee's opinion this service should carry all the African traffic, through a new valve station near Nairobi, East Africa, and the ex-German station at Windhuk, South Africa, the latter being transformable at slight expense into an efficient valve station. For the Indian, Far Eastern, and Australian service it is proposed that valve stations should be erected in England, near Cairo in Egypt, in India, at Singapore, at Hong-Hong, and on the north or west coast of Australia.

The Imperial wireless scheme recommended is shown in the accompanying map. The Committee is of opinion that by this procedure official, commercial, and Press traffic will be carried reliably, expeditiously, and economically, and that essential strategic needs will be met.

Communication between England and Canada can be secured by similar valve stations in each country, but this highly desirable service must be decided upon by conference between the British and Dominion authorities. A satisfactory commercial service between Western Canada and Australia is regarded as of such extreme difficulty at the present stage of development as to be beyond practical consideration.

The capital cost of the scheme outlined above is estimated at £1,243,000, of which £853,000 would be payable by the Imperial Government. The annual charges, including interest on capital at 6½ per cent., and complete amortisation of all plant and buildings within a proper period, are estimated at £425,000, of which £268,000 would fall upon the Imperial Government. The total estimated annual traffic for the whole service would be about 10,000,000 words, producing a revenue of £325,000, of which £205,000 would be receivable by the Imperial Government.

On balance, the opening years would show an annual loss of about £100,000, of which £63,000 would be payable by the Imperial Government, £4,000 by the Indian Government, £20,000 by the Australian Government, and £13,000 by the South African Government. The Committee is of opinion that this initial loss is less than might have been expected; that its proposals represent the quickest method, consistent with the greatest economy, by which a satisfactory Imperial service, embodying the latest scientific progress, can be secured; that these losses will decrease year by year, and will be turned into a profit in ten years; and that in any case the loss may be regarded as negligible in comparison with the Imperial benefits conferred.

The chain of stations, at least three-quarters of the material of which would be supplied by commercial manufacturing firms, should be completed in two years after the issue of the plans and specifications.

The practical procedure to give effect to the Committee's recommendations would be the creation of a Wireless Commission of about four members to plan the stations as units, in accordance with modern wireless science, in order to secure the necessary correlation of all the constituent factors. This Commission would presumably be no longer required when the stations were completed. The Committee proposes that the construction of the stations to the plans furnished by the Commission should be entrusted to the engineering department of the Post Office, which possesses the organisation and experience necessary to the satisfactory execution of this work, and to the corresponding overseas authorities.

The Committee has examined, as requested, the proposals submitted to the Government by the Marconi Co.* It finds these too vague to admit of detailed comment, but so far as it can judge the scheme it appears to be of a scope and magnitude so great, and involving such heavy capital and annual expense, that even if it carried the whole of the traffic handled to-day by all the cable companies serving the same regions, it could only be remunerative, if at all, by duplicating the Postmaster-General's system of inland and

* ELEC. REV., April 2nd, 1920, pp. 423-6.

* ELEC. REV., March 19th, 1920, pp. 377-9.

continental telegraphy, and by competing with the State telegraph systems of the various overseas Governments. It is further of opinion that if fully carried out it would be prejudicial to the interests of free wireless research and independent development.

Upon the technical side of the proposals the information given affords no basis for judgment, but the Committee does not accept the statement that an Imperial service can be satisfactorily carried out only by the use of a particular patent owned by the company.

On the other hand, the Committee is of opinion that of Imperial wireless traffic were carried out by the State, long-distance wireless traffic with foreign countries might properly be left, under suitable conditions, to the commercial companies. Both services would profit by this healthy competition.

The considerations and arguments upon which the above conclusions are based are set forth in detail in the report.

LEGAL.

Spencer *v.* Adams.

In the City of London Court, on June 29th, Mr. George H. Spencer, Tufnell Park Road, sued Mr. Maurice Adams, Bedford Park, for £15 19s. 10d. for installing the electric light at premises at Hounslow and Ruislip. Plaintiff said that the work came altogether to £30, and he had been paid half on account. He admitted in cross-examination that he gave the estimate to Maurice Adams Concrete Construction Co., Ltd., Fore Street, of which the defendant was the managing director, but he was not suing the company because he did not think they were liable.

Mr. Costello, defendant's counsel, said the company gave the orders and paid the sum mentioned on account. All the documents showed that the company were the people with whom the plaintiff dealt and not Mr. Adams personally.

Assistant Judge Jackson was afraid the plaintiff had made a mistake. Why had the company not paid instead of allowing the defendant to be sued?

Mr. Costello said unfortunately the company was in liquidation. This was the whole of the trouble.

Assistant Judge Jackson said it was very hard on the plaintiff that he had fitted up the premises nominated by the defendant's company, and he had not been paid.

Mr. Costello replied it would also be hard on Mr. Adams if he had to pay the debts of the company.

Assistant Judge Jackson agreed, and said he did not think the defendant was personally liable. Judgment for him with costs.

German Lamp Patents.

Before Mr. Justice Russell, in the Chancery Division, on Friday, July 2nd, an action was tried in which the Osram-Robertson Lamp Works, Ltd., asked for a declaration that they were the beneficial owners of letters patent Nos. 2284 of 1912, 15360 of 1913, and 19729 of 1914, the latter granted to the Public Trustee, and the two former vested in the Public Trustee by an order of the Board of Trade of October 30th, 1918, and that they were entitled to have the letters patent transferred to them. The Public Trustee and the Deutsche Gasgluhlicht Aktiengesellschaft, of Berlin, were cited as the defendants.

Sir Arthur Colefax, K.C., and Mr. Austin Cartmell appeared for the Public Trustee as the custodian of the letters patent; and Mr. J. Hunter Gray, K.C., and Mr. James Whitehead, for the plaintiffs.

The letters patent related to improvements in connection with the manufacture of wolfram and molybdenum filament lamps, and Mr. Gray said there was an agreement with the German company under which the plaintiffs were entitled to the benefit of any improvements in this country which might be made by the German company. From 1907 quite a number of improvements were communicated to them by the German company, were patented by the plaintiffs, and the patents were now vested in them. As regarded the first two the Germans were pure trustees, the whole of the beneficial estate having passed to the plaintiffs. As to the third, the communication of the invention was made in June, 1914, but the necessary papers could not be completed before the war broke out. As a matter of law a person who got communication from abroad of an invention was entitled to apply for a patent for it as being the first importer.

His Lordship: Of what?

Counsel: Of the invention. The person who first introduces the invention into this country from some other country, however he does it, is entitled to be the first and true inventor within the meaning of the Act. As regarded the present case, he submitted that the whole of the beneficial interest had passed before the outbreak of war.

Sir Arthur Colefax explained that the position of the Public Trustee was that of custodian of the patents granted to the German company, and it was for the plaintiffs to prove that they had the legal right which they claimed. In regard to the first two, he thought they had proved their case, but with regard to the third there was some question.

His Lordship, in giving judgment, said the procedure under the agreement was that the invention or improvement, as the case might be, which the German company made, was disclosed to the plaintiffs, and the necessary papers were prepared over here to be lodged at the Patent Office. The patent would be sealed in favour of the German company, and the German company would assign it to the British company. That practice was followed in all cases except two, the first two. As regarded those, what happened was that the patents were granted to the German company, and the assignment by them to the plaintiffs was executed. But when the war broke out they were, under the order of the Board of Trade, vested in the custodian. As regarded the third patent, by the time the papers were ready to be sent to Germany for signature war had broken out, and the papers could not be sent, and the patent was granted to the custodian as patentee. The answer on behalf of the custodian was that the patents were not patents within the meaning and scope of the agreement of 1907. The first related to the description, and as wolfram and molybdenum formed part of it he held that it concerned an improvement of filament lamps of these particular descriptions, and was within the meaning of the agreement. The second dealt with the addition of a reflecting surface to the globe of the lamp, and the third was an invention designed to reduce the temperature of the gas in the half-watt lamp so that the wires leading into the lamp would be less likely to be fused. He held that all three letters patent came within the scope of the agreement and should be assigned to the plaintiffs by the custodian, and he made an order accordingly.

Engineer Sentenced.

At Greenock Sheriff Court, John Keith Robertson, engineer, was sent to prison for sixty days for damaging the electrical machinery in the shipyard of Messrs. Ferguson Bros., Port Glasgow. It was stated that Robertson had had a dispute regarding wages, and had left the firm's employment. He returned on Saturday night, entered the works, and put the electrical machinery out of gear by running away the oil and throwing sand into the bearings. When the workmen tried to start the engines on Monday morning a large volume of smoke and flames burst out, the men's lives being endangered. A number of men were thrown idle, and £100 in wages was lost.

Failure to Protect a Crane.

At the Gateshead-on-Tyne Police Court, on 2nd inst., Sir W. G. Armstrong, Whitworth & Co., Ltd., were charged with having failed to protect an overhead electric crane "so as to prevent danger, so far as was reasonably practicable" at Close Works, on April 29th.

Mr. Lauder, H.M. Inspector of Factories, said the crane in question was supplied with direct current from trolley wires which were underneath the crane, but above the crane, on the roof girders, were three other trolley wires supplying alternating current to other cranes. On the top of the crane in question was a carriage, and on one side of it was a platform which faced the trolley wires. The three wires were immediately over part of the platform, the distance being 4 ft. 1½ in. They carried a 440-volt current. On the day of the charge two men were sent up to repair the crane; the wires were alive.

J. Langley, chargeman millwright, said since the inspector's visit a fencing had been erected on the crane to prevent contact with the wires.

A fine of £10 was imposed.

Charge of Stealing Lamps.

At the West London Police Court, on Saturday, before Mr. Boyd, Jack West, 17, was charged on remand with stealing electric lamps. The evidence given at the previous hearing was reported in the Electrical Review, June 25th, p. 809.

To Det.-Sergt. Parsons he confessed to 17 cases, and had rendered assistance to the police in recovering the property.

He had not been in the hands of the police before, and the magistrates bound him over in £10 to come up for judgment if called upon within two years.

Electricians as Shopbreakers.

At Scarborough Quarter Sessions, on Friday last, three brothers, Harry (30), Ernest (24), and William Thompson (22), all living and carrying on a business as electricians at 114, Victoria Road, Scarborough, were sent to prison in connection with shopbreaking on the Spa and at North Side, and stealing a large quantity of valuable goods. The two younger brothers admitted the thefts, and the elder pleaded guilty to receiving. It transpired that the young men are natives of Rotherham, and only recently settled in Scarborough, where they had established what seemed to be a *bona-fide* business. They had agreed to purchase their premises, and deposited £100. Ernest had been caught in the act of shopbreaking and the other two, who escaped, were arrested at home, where the proceeds of twelve robberies were recovered. The father of the prisoners said he could not account for their conduct, unless it could be attributed to their life in the Army. The police had no record against the men.

The Recorder sent Harry to prison for three months, and the others for six months, all in the second division.

BUSINESS NOTES.

The "Electrical Review" Index.—The Index to Vol. 86 of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for sixpence post free. Any reader or advertiser, at home or abroad, who requires a copy for binding or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

English Electric in Australia.—The appointment of Mr. G. Weymouth, of G. Weymouth Pty., Ltd., Melbourne, and Messrs. J. B. Nicholson and A. A. Stewart, as managing directors of the English Electric Co., of Australia, has been confirmed. An order has been received from the New South Wales Railway department for two turbo-alternators complete, to be manufactured locally. These will be the first completed units to be manufactured in Australia. The contract amount exceeded £60,000.—*Tenders.*

The A.E.G. in Sweden.—The Elektriska Aktie-Bolag A.E.G. has decided to increase the share capital from 1,000,000 kr. to 5,000,000 kr., by the issue of new shares of 1,000 kr. at par. The right of subscription is exclusively held by the A.E.G. of Berlin.

Big Scheme for Dowlais Steel Works.—The *Daily Chronicle* states that MESSRS. GUEST, KEEN & NETTLEFOLD, LTD., are preparing a site for the erection of an electrical power station, a range of coke ovens, and other developments, at Dowlais steel works, at a cost of three-quarters of a million.

The Crisis in Japan.—An Exchange Telegraph dispatch from Tientsin states, under date July 1st, that owing to the serious industrial outlook in the copper and steel trades at Osaka, the important Japanese centre, the Japanese Government has come to the relief of these industries and is advancing 20 million yen, thus averting an increase of unemployment.

Bankruptcy Proceedings.—J. W. LEWSLEY, electrician, late of 103, Mansfield Road, Nottingham.—First and final dividend of 20s. in the £ payable July 14th at the Official Receiver's offices, 4, Castle Place, Nottingham.

IVOR JAMES HODSON, and BASIL HOWARD NEWMAN (trading as Hodson & Newman), electrical engineers, 85, Queen Street, Exeter.—The first meeting of creditors in this matter was held on July 1st at Exeter. The statement of affairs showed liabilities amounting to £745, and assets £225, thus leaving a deficiency of £520. It was stated in the deficiency account that the net trading loss from July 10th, 1919, was £138, and £150 was put down for depreciation in stock-in-trade. The Official Receiver observed that the debtors had filed their petition in consequence of a levy of execution upon their stock-in-trade. They commenced business at Exeter on July 10th, 1919, with a capital of £20. The chief item in the unsecured claims was £524 for accumulators, lamps, and other electrical accessories. They allege as causes of failure want of capital and bad trade, particularly since Easter, 1920.

BERNARD PORDES (trading as the United Electrical Manufacturers Co.), 18-22, Christopher Street, London. The following are creditors :—

Arnold, A.	£36	Morgan Crucible Co., Ltd.	£83
Blackwell, Sons & Co., Ltd.	74	Magnus, D. & A.	19
Baron, S.	18	Mayer, E. E., & Co., Ltd.	16
Beatrice & Co., Ltd.	72	Neale, G. W.	78
Blythe & Co., Ltd.	19	Pillivant, F. T.	158
Connell & Co., Ltd.	84	Rotherham & Co., Ltd.	11
Cromil Engineering Co.	15	Rhodes & Son, Ltd.	17
Copley & Bank, Ltd.	1,076	Syer & Co., T. J.	16
Dericott, H.	54	Smith & James, Ltd.	12
Drayton Paper Works	26	Smith & Davis, Ltd.	84
Dunn Davis & Whitner	120	Steiner, E.	14
Dussek Bros., Ltd.	14	Sweeney & Blockridge	164
Express Lift Co.	60	Testi & Sons	80
Foord, J., & Co.	22	*Tobacco*	21
General Electric Co., Ltd.	21	Toy Campbell & Co.	68
Hillbar Press	12	United Kingdom Tea Co., Ltd.	23
Hardware Trade Journal	25	Wilkinson & Sons	42
Hardwareman	82	Pordes, M.	148
Hall & Hall	88	Pordes, A.	173
Hatton & Co.	54	Bankers	495
Hill & Co.	12	Barley & Co., Ltd.	101
Morris & Yeoman	56	German creditors	1,894

Mails to Australia.—Australian papers just to hand complain bitterly, and not without justification, of the serious irregularity in the arrival of mails from this country. It is a great handicap to business. A mail recently arrived after a lapse of 28 days! During all that time Australian business houses were out of touch with the trade centres of Europe, and when the mail referred to was received, it proved to be in reality three or four mails in one, and numbered over a million letters! We do not know that the arrivals in this country have been much more regular. In the interests of traders both here and there it is important that the authorities should do their utmost to afford a regular and dependable means of postal communication at the earliest possible date.

Supplies for Canada.—H.M. Trade Commissioner in Winnipeg (Mr. L. P. Beale) has received an inquiry from a Winnipeg company for vulcanite battery jars and celluloid sheets required for the construction of batteries. Deliveries from the United States are said to be very uncertain, and the company state that if a satisfactory source of supply can be found within the United Kingdom, it is hoped to conclude permanent arrangements with United Kingdom manufacturers. The D.O.T. (Capt. Vandeleur, Room 49, "Victoria 9040; Ext. 29"), has full particulars and samples.

Strikes.—The strike of Southport electricians, which involved about 40 members of the Southport branch of the Electrical Trades Union, ended on Monday, June 28th, the masters agreeing to concede the men's demands.

The management of the BRITISH INSULATED AND HELSBY CABLE WORKS, at Prescot, intimated that their men on strike would be reinstated, but the men remained out, and have been endeavouring to induce the members of the others Unions who remained at their posts to join them. In this they failed, the men declaring decisively in favour of a continuance of work as against a lock-out. As we go to press, we learn that the strike has been settled and after a few days' stoppage, 4,000 workers have resumed their duties. Two men who had been dismissed, have been reinstated and the firm will loyally carry out any award or recommendation from the Councils which have in hand all matters regarding wages and conditions of employés.

Lead.—MESSRS. G. CAWSON & Co. report (July 3rd) :—

The position with regard to supplies remains unchanged. There is still an ample supply offering for all requirements. The actual general consuming trade is without improvement. Electrical works continue to take lead in fair quantities. Some of them, however, have covered their requirements for months ahead. The inquiry from Japan has entirely ceased. America, seems to be still in the market. The Customs difficulties, however, prevent business bring carried through. Lead is still coming forward regularly from Spain and Australia. . . . The position in Mexico continues to improve, and this will, no doubt, eventually tend to ease the American situation. . . . The outlook for the present rather points to a steady market.

MESSRS. JAMES FORSTER & Co. state :—

The consumption of lead is well up to pre-war figures, and tends constantly to increase. Rollers report active business both for sheets and pipes, and the evidence generally on all hands, particularly in the City, shows that at last the building trade is getting into its stride. The electrical trades are full of orders. As far as imports are concerned, there is no evidence to justify hopes of increased quantities, and without same there is only one result to existing conditions sooner or later, and that is pronounced scarcity.

Trade Announcements.—Owing to rapid growth of business, the WESTERN ELECTRIC CO., LTD., has acquired an additional building at 60 and 62, Finsbury Pavement, London, E.C. (Telephone Nos. : "London Wall 7608 and 7609"). The export sales department has been removed from Oswaldestre House, and the supply sales department from Norfolk House, to the new address, and all sales business will be carried on from Finsbury Pavement in future, where they now have extensive showrooms. The registered offices of the company will continue at Norfolk House.

MR. F. CARR, B.ENG., A.M.I.E.E., has commenced business as an electrical engineer at Sun Buildings, Collingwood Street, Newcastle-on-Tyne.

THE COVENTRY ELECTRICAL AND ENGINEERING CO. have opened showroom premises at 23-24, Hertford Street, Coventry.

MR. E. GOLDSTON, electrical engineer, of Northampton, has removed his business from 28, Marefair, to 13, Horse Market.

THE SWIFT ELECTRICAL, LTD., have moved to larger premises at 6, Cork Street, Old Bond Street, W. 1, where they will carry a larger stock of accessories.

MESSRS. M. K. COOPER & Co. (M. K. Cooper, late of Messrs. T. C. Smith & Co., of Aberdeen) have commenced business as electrical engineers at 15/21, Chapel Walks, Liverpool.

Germans in China.—The Shanghai correspondent of *The Times Trade Supplement* says it is reported that arrangements have been made for the supply by German manufacturers of all the necessary plant and machinery for a colliery which is being opened up in the Province of Chekiang, near Hangchow. "The German engineer who is to superintend the installation of the plant has already arrived, and it is understood that the machinery is now on its way. The engineer was formerly employed by the Chinese Government, and was repatriated when the Germans were sent back to Germany. In view of the fact that France is finding it difficult to obtain the necessary machinery from Germany to restore the collieries destroyed by the German army, it is curious that Germany should be able to sell colliery machinery to China."

Catalogues and Lists.—MESSRS. HIGGS BROS., Dynamo Works, Sand Pits, Birmingham.—Monthly Magazine, July, 1920 (24 pp.), containing stock lists of dynamos and motors, and notes on the prevention of sparking.

MESSRS. WARD & GOLDSTONE, LTD., Sampson Works (Salford), Manchester.—Catalogue No. A105 (75 pp.). A priced and illustrated list of lighting and power supplies covering a wide range, and including ironclad switches, fuses, cables, insulators, bell materials, &c.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Descriptive List No. 8,037 (12 pp.). An illustrated pamphlet giving complete details and specifications of a ventilated interpole traction motor (Type G.E. 200 K).

AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C. 1.—Heat Treatment Bulletin for May, 1920, "Concerning Pyrometers." A pamphlet dealing with the correct methods to employ in pyrometry.

THE EDISON SWAN ELECTRIC CO., LTD., Ponder's End, Middlesex.—A priced and illustrated list of new sizes of drawn tungsten, gas-filled lamps, 40 and 60 watts.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C. 4.—Installation Leaflet No. P2,323, describing the rotary converter equipment installed by the company at the Landore Tube Works.

Electric Motors for Canada.—The Department of Overseas Trade in London has news from Toronto to the effect that a local firm, who use motors varying from ½ H.P. to 5 H.P. for pump work, desire to receive quotations with particulars of delivery from United Kingdom firms for electric motors of a high starting torque and other characteristics similar to those of the American "Wagner" and "Century" makes. The name and address can be ascertained from the D.O.T.

The Machine Tool and Engineering Exhibition.—The Machine Tool and Engineering Exhibition will be held at Olympia in September next. The whole of Olympia has been booked up for some months past, and the number of separate exhibitors will exceed 200. It is anticipated that the public interest in the exhibition this year will be greater than that shown in any previous exhibition of machine tools, because the production of munitions during the war educated the British public for the first time in the fundamental importance of machine tools to British industry. There will be over 1,000 machines in actual operation. The exhibition is being organised by the Machine Tool Trades Association, and it will be held from September 4th to 25th.

Book Notices.—We have received a copy of the summer number of *Punch*; it is an extra number, beyond the ordinary weekly issues, and is thoroughly well worth the shilling. The cover depicts Mr. Punch in bathing costume playing cricket on the sands, and puts you in holiday mood at once. More than 140 pictures are included, and an excellent feature is a special section in full colour.

"Etude sur la traction électrique par courant continu; alimentation des réseaux de tramways et de métropolitains." (31 pp.) By F. Guery. Reprinted from the *Revue Générale de l'Electricité*. This is a reprint of a communication to the Société Française des Electriciens, and is a comprehensive study of the working of electric traction systems gathered by the author in his capacity of chief engineer of the electrical department of the "Omnium lyonnais" railway and tramway systems.

"The English Electric Journal." Vol. I, No. 3 (40 pp.).—The July issue of this journal contains a number of interesting and informative articles. Among these are a description of the Phœnix Works, Bradford; a description of a D.C. geared turbo-generator installation, and notes on steel works drives—all photographically illustrated.

"Reports for the year 1919 on the Science Museum, and on the Geological Survey and the Museum of Practical Geology." (33 pp.) London: H.M. Stationery Office. Price 3d. net.—The report shows that the daily average of visitors to the Science Museum rose to over 1,100, an advance on pre-war figures. The addition of numerous new exhibits is recorded in detail, among them being a double-needle telegraph instrument (1847), the original Neale sounder (1873), the Henley needle galvanometer used in receiving the first trans-Atlantic message (1858), and a collection of vacuum tubes used by the late Sir William Crookes in his researches.

"Science Abstracts" (A and B). Vol. XXIII. Part 5. No. 269. May 31st, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"*Proceedings* of the Physical Society of London." Vol. XXXII. Part 4. June 15th, 1920. London: Fleetway Press, Ltd. Price 4s. net.

"The Metropolitan-Vickers Gazette." Vol. V, No. 86 (23 pp.).—The May number of this excellent house organ contains articles on "Research and the Supply of Electric Power," notes on the Clyde Valley E.P. Co.'s Yoker station, and a description of a 25,000-KW. alternator installed at the Stuart Street station of the Manchester Electricity Department.

Dissolutions of Partnership.—R. WILLIAMS & CO., electrical engineers, 89, Liverpool Road, Stoke-on-Trent.—Mr. R. Williams and Mr. J. H. Waterland have dissolved partnership. Mr. Williams will attend to debts and continue the business.

ELECTRICAL SPECIALITIES CO., electrical specialists, 18, Nelson Street, Liverpool.—Winifred E. Maddocks and A. B. Gregson dissolved partnership. Debts will be attended to by W. E. Maddocks.

Annual Outings.—On Saturday, June 26th, the CRYPTO ELECTRICAL CO., LTD., went for their annual outing, spending the day at Southend-on-Sea. Dinner was served at the Palace Hotel, where some 200 employés were present, the chairman of the company, Mr. T. E. Goodyear presiding, supported by Mr. C. R. Shaw (managing director), and Mr. J. E. Buchanan (works manager). Regrets were expressed that the senior managing director, Mr. J. G. Shaw, could not be present owing to his being abroad.

On Saturday, June 26th, the annual works outing of the employés of SIMPLEX CONDUITS, LTD., took place, a party of 300 journeying to Bewdley-on-Severn, by special train. They were accompanied by most of the management staff, and by a number of the outside managers and representatives; a considerable number of ladies were present. Sports were held in the morning. The luncheon was presided over by Mr. L. M. Waterhouse, technical director of the company, who, in response to the toast of "The Firm," congratulated the committee of the Simplex Social and Welfare Club on the excellent arrangements for the day. The outing was the seventeenth, although the first since 1914. A photograph was taken of those present who had been with the company at the period of the first outing; they numbered 36.

The staff and employés of MESSRS. GENT & CO., LTD., Faraday Works, Leicester, held their annual outing on Saturday, June 26th, at the Boat House, Market Harboro. The day was spent in the grounds and on the water. During the morning a cricket match, arranged between the machine shop and the rest of the employés, was played, and resulted in a win for the machine shop by 10 runs. After luncheon the sports items were keenly contested. The tug of war resulted in the single men defeating the married team, and thereby holding the cup until the next annual event. After tea the prizes were presented to the successful competitors by Mrs. Parsons, supported by Mr. Hardy Parsons, managing director. The directors of the firm gave the outing their presence and enthusiastic support.

The employés of MESSRS. PAGE & MILES, LTD., electrical engineers, of Brighton, Worthing and Eastbourne, recently held their first outing since the War. Accompanied by the directors, Messrs. H. J. Miles, E. J. Page and J. T. Baker, and the secretary, Mr. J. Harold Penfold, they left the head office, in three motor char-à-bancs, to spend the day at Tunbridge Wells, with the Carlton Hotel as headquarters. Here they were joined by some friends from London. At dinner "The Firm" was proposed by Mr. F. Patching, and responded to by the chairman, Mr. H. J. Miles, who said that their number had grown from 28 in 1889, to 82 to-day. He welcomed back those who had served with the Forces. He also referred to the loss sustained during the year by the death of the chairman (Councillor J. W. Penfold) and three members of the staff, Messrs. A. H. Page, W. Miller, and F. Lowe. Other toasts followed.

MESSRS. DYNELEX, LTD., held their first annual outing on Saturday, July 3rd. It was organised by the employés, and a most successful day was spent at Brighton. Major H. J. Holmes, the managing director, briefly addressed the party at the luncheon.

The directors and staff of MESSRS. MACDONALD, SYER & CO., LTD., engineers, of Gray's Inn Road, London, flew from Cricklewood to Margate on the 3rd inst., the party being conveyed by three aeroplanes, and one of the Handley-Page machines carried 16 passengers, women as well as men. This machine on the way down did the journey in approximately 50 minutes, whilst one of the smaller machines, a D.H. 4, did the homeward journey in about 30 minutes: the other employés went down by train, but the pilot kindly offered to carry extra passengers back, and there was

keen competition for the seats. The party landed at Manston Aerodrome, and were conveyed by car to the West End Restaurant, Margate, where a most enjoyable lunch was partaken of, accompanied by instrumental and vocal selections. The speeches with which the luncheon concluded showed plainly the true appreciation and goodwill which exists in this firm between employé and employer. The directors who accompanied the party were Mr. C. Stanley Syer and Mr. L. Evans. We give a view of the big aeroplane, with the passengers and pilot.

This is the pioneer outing of its kind, and, no doubt, many other firms will now follow this example. The firm of Macdonald, Syer and Co., Ltd., certainly live up to their telegraphic address, "Determined," London.

Company Liquidations.—PORTABLE TOOL AND ENGINEERING CO., LTD.—Winding up voluntarily (resolution of June 22nd). Liquidator, Mr. H. D. Read, 13, Lime Street, E.C. Meeting of creditors is called for July 9th. Particulars of claims, &c., must be sent to the liquidator by July 23rd. A petition for the winding up was presented to the High Court on June 25th, by MESSRS. ACCLES & POLLOK, LTD., of Paddock Works, Oldbury, Worcester, and will be heard on July 13th.

LITHANODE, LTD.—Winding up voluntarily. Liquidator, Mr. F. A. Bell, Billiter House, Billiter Street, E.C. Meeting of creditors, July 16th.

GLOBE ELECTRIC CO., LTD.—Particulars of claims, &c., must be sent by July 24th to the liquidator, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C.

For Sale.—The Stores and Works Committee of the East Sussex County Mental Hospital at Hollingby, invite offers for 9 tons of old lead battery plates, 2½ cwt. old copper rods, 220 glass boxes, &c. For particulars see our advertisement pages to-day.

MR. H. L. FARMER, of Messrs. Leopold Farmer & Sons, of 46, Gresham Street, the Receiver, invites offers for the lease and plant of the Anti-Rust and Metal Deposition Co., Ltd., 72, Granville Road, Cricklewood Lane, N.W.

Copper and Lead Prices.—MESSRS. F. SMITH & Co. report, July 6th :—Copper (electrolytic) bars, £109, £4 increase; electrolytic sheets, no change; electrolytic wire rods, £124, £4 increase; electrolytic H.C. wire, no change; silicium bronze wire, 1s. 11½d., ½d. increase.

MESSRS. JAMES & SHAKESPEARE report, July 7th :—Copper bars (best selected), sheets, and rods, £161, £3 increase; English pig lead, £35 10s.; 10s. increase on the week's prices.

London Exhibition of French Products.—An exhibition of French products, organised by the Office Commercial Française en Angleterre, will be held from July 15th to July 30th, in the Exhibition Hall at 153, Queen Victoria Street, E.C. 4. On this occasion the exhibition will include the following and other articles :—Philosophical and geometrical instruments, electrical, medical, and surgical apparatus, laboratory accessories, &c.

Wages in Electricity Supply.—The following is a resolution passed by the Employers' Side of the Home Counties (No. 9 Area) Joint Industrial Council on June 30th on the decision made by the National Joint Industrial Council for the Electricity Supply Industry to refer to arbitration the demand made by the Trade Unions' side of the National Council for an advance of 6d. per hour on present rates to all workpeople over 18 years of age, and 3d. per hour to all those under 18, as contained in their letter dated June 18th :—

"Resolved that the Employers' Side of the Home Counties (No. 9 Area) Joint Industrial Council strongly deprecate the action taken by the National Council on June 18th in referring to Arbitration to the Industrial Court the claim made for an advance of 6d. per hour as contained in the letter from the Trade Unions addressed to the National Council and dated June 18th, as the Employers' side of this Council consider that in such matters action should not be taken without reference to the District Councils, and without the District Councils having any opportunity either to discuss the matter or to forward their views to the National Council, and the Employers' Side of this Council particularly regret that such reference was not made to them in the present case, seeing that this Council has just fixed consolidated rates which, the Employers' Side claim, cover and include all increases applicable or put forward to date and take into account all grounds for any increases which occurred up to the time of formal approval by the National Council (June 21st), and further, the majority of the undertakings in the area cannot even pay these consolidated rates until they have received relief from the Minister of Transport. It is, therefore, entirely out of the question even to consider any further increase, and, whatever may be the result of the Arbitration, to which they refuse, in view of the above, to become parties, directly or indirectly, or whatever subsequent recommendations of the National Council may issue in connection therewith, the Employers' Side of this Council must most emphatically state that they cannot receive same."

The Secretary for the Employers' Side informs us that official notice has been given to the Ministry of Labour that in view of the special circumstances of the No. 9 Area, Home Counties Industrial Council, the Employers' Side definitely refuse to become parties to the Arbitration, and have asked the Ministry of Labour to take steps to make this clear in the terms of reference and to embody in the award a specific notice that the award does not apply to the undertakings in the Home Counties Area.

The Secretary has also asked us to state that the above resolution was put before the whole Council, but that the Labour Side of the Council decided that they could not support it, and the resolution therefore was passed by the Employers' Side only.

French Company Notes.—Appareils Electriques et Compteurs Garnier is the title of a company formed at Lyons (23, Rue Cevenna), with a capital of 1,200,000 fr., for the manufacture of, and trade in, electric meters, and, more especially, a current meter on a new principle, invented by M. Garnier.

Under the style of La Construction Electrique Française, has been formed at Clechy (Seine), (12, Avenue Léon-Gambetta), a company for the manufacture, sale, installation, or working of all kinds of electrical material and apparatus. The capital is 210,000 fr., in 500 fr. shares, 60 being allotted to M. René Chadeville as payment for his assets.

With a capital of 1,789,220 fr. a company has been formed at Paris (82, Boulevard Richard Lenoir), under the style of Veuve P. Delaion et Cie. for the manufacture of electric cells and bells.

There has been established at Marseilles (14, Place Castellane), a company styled the Midi Electric, with a capital of 500,000 fr., for the erection, repair, and trade in electrical machinery, gas, and water; also by-products of their working.

Salvy et Beauté is the name of a company just launched for trading in electrical material. Its capital is 129,049 fr., and its offices are at 27, Faubourg St. Martin, Paris.

With the title Matériel de Tramways et Electricité a company has been formed at Paris (36, Boulevard Magenta), with a capital of 300,000 fr., for the manufacture, purchase, and sale of material for electric lines and installations, tramways, railways, &c.

Société d'Etude pour Liaisons Téléphoniques et Télégraphiques à Longs Distances is the name of a company whose objects are the manufacture and installation and working of long-distance telegraph and telephone networks of any system. Its capital is 500,000 fr., and its offices are situated at Paris, 25, Rue de Quatre Septembre.

E.P.E.A.—At a meeting held at Maidstone, on June 26th, a Kent Section of the E.P.E.A. was formed with the following officials :—Chairman, Mr. H. Wilson (Maidstone); vice-chairman, Mr. Lewis (Canterbury); secretary, Mr. E. E. Pope (Maidstone); assistant secretary, Mr. C. Tritton (Maidstone); treasurer, Mr. G. E. Wintle (Maidstone). The following were also elected to the Committee :—Messrs. Wampach (Folkestone); Pownall and Woolgar (Tunbridge Wells); Bennion (Canterbury); Inge and Dunsby (Gravesend); and Roberts (Richborough). Messrs. Wilson and Lewis were appointed delegates to the Divisional Council, and the former was also appointed Section representative on the District Joint Board.

South African Electrical Supplies.—Our Cape correspondent writes :—"For some time past British electrical supply firms have been very dilatory in executing orders for sundries for South Africa. For instance, no ceiling roses have been arriving for several months, and substitutes have had to be used. The supply firms usually promise quick delivery, but months pass and no goods are received. It cannot be too strongly impressed on British firms that this is acting very prejudicially on the British export trade and driving South African buyers into the foreign markets—in particular the Germans are again sending out catalogues and circulars wholesale."

Hydro-Electric Development.—The *Times* Paris correspondent says that at a general meeting of the International Chamber of Commerce, it was resolved to recommend all countries, in order to increase the world's stocks, to hasten the utilisation of hydro-electric power and the carrying out of measures which tend to the use of mineral fuel in the most scientific and economical way, and to develop research in the extraction of the coal and fuel resources of the world.

E.P.D.—The Chancellor of the Exchequer stated last week that it was impossible to alter his proposals respecting the E.P.D. increase to 60 per cent. The Finance Bill has been before the House of Commons this week.

The State of Employment.—In reply to a question in Parliament, last week, Dr. Macnamara said that employment in the principal industries of the United Kingdom was still maintained at a high level, and was much better than a year ago. In shipbuilding, although employment was still good, there had recently been some decline owing to a shortage of raw materials.

Broken Hill Strike.—It was reported by Reuter's representative at Sydney, on July 2nd, that the Conciliation Commissioner of the New South Wales Government had called a conference between the Broken Hill mine-owners and miners.

Inquiries.—The addresses of makers of, or agents for, the "Berwick" electric rivet heater are asked for.

A correspondent asks for the name of the manufacturer of "Etcholite" for frosting electric lamps.

The Batti-Wallahs.—On Monday, July 19th, at the Holborn Restaurant, at 1 o'clock, the Batti-Wallahs hold a Grousers' luncheon gathering.

LIGHTING AND POWER NOTES.

Australia.—SYDNEY.—Owing to the rising cost of coal, which is 17s. 6d. as against 8s. two years ago, the City Council is considering the purchase of a coal mine. Three likely mines were suggested, but the most suitable appears to be the Awaba Colliery. The purchase price will be about £50,000, and the equipment necessary to raise 1,100 tons a day will cost approximately £54,000, bringing the total expenditure on the project to £104,000. The construction of a power station, costing £2,174,000, at Awaba, is also suggested.

Belmont (Co. Durham).—ELECTRIC LIGHTING SCHEME.—At a special meeting a large majority was obtained in favour of a scheme of electric lighting for the parish.

Bexhill.—YEAR'S WORKING.—The financial result for the year ended March 31st last from the electricity undertaking, was a gross profit of £6,400. The payment of loan charges, taxes, &c., left a balance of £344. It is stated, however, that a charge of £700 for the provision of meters has to be made against revenue.

Brighouse.—YEAR'S WORKING.—The annual financial statement showed that in the electricity department, which receives a bulk supply from the Yorkshire Electric Power Co., there was a net profit of £256, an increase of £141 on the profit of the previous year. There has been no advance in price during or since the war, and the charge is the lowest, with one exception, in Yorkshire.

CONVERSION OF SUPPLY.—Having rejected a proposal by the Yorkshire Electric Power Co. for the conversion of the direct-current supply to alternating current, the Electricity Committee suggests as an alternative, that certain users near the sub-station might be supplied with alternating current, provided the cost of the conversion was borne by the company, and that the same charge was made as for the present direct-current supply. Further consideration of the scheme for the extension of the sub-station to cope with increased demand has been deferred pending the formulation of a full scheme, together with an estimate of the cost. The Power Co. is to be asked to furnish plans and estimates of the extensions required.

Bury.—Extensions.—Borrowing powers for £95,000 are being sought by the Corporation for extensions to the electricity undertaking. Since the works were established 24 years ago, the capacity has increased from 304 to 8,700 kw. The extensions already in progress will ensure an increase of 2,000 kw., but applications for power amount to nearly 4,000 kw. Last year the consumption amounted to 15,367,000 units.

Continental.—Belgium.—The hands employed by the Centrale électrique du Hainaut, at Montignies-sur-Sambre, have struck for an increase of wages. As a result, a number of works have had to close down, throwing some 10,000 men out of work.

Spain.—A concession has recently been granted by the Spanish Government for the establishment of plant to utilise the water power of the Rivers Genil and Riofrio, near Loja, for the generation of electrical energy for lighting and power purposes.

Halifax.—Electricity Supply.—Disappointment is felt in adjoining districts at the failure of the Corporation to obtain the consent of the House of Lords to the inclusion of the electricity extension clauses in its Parliamentary Bill. Provisional arrangements had been made with the Corporation by both the Luddenden Foot and Mytholmroyd Union District Councils, the former of which intended to have the streets lighted by electricity during the coming winter, and it is considered that the only course now will be to immediately open up negotiations with the Yorkshire Electric Power Co., and, if suitable terms can be arranged, to obtain a supply from that company, whose cables already pass through the district. At Mytholmroyd further developments are awaited. It would be possible to tap the company's cables, but to use the latter's service for lighting would necessitate the putting down of transformer plant.

New Sub-Station.—The Tramways and Electricity Committee recommends the purchase of one 400-kw. rotary converter, transformer, and starting switchgear, and the necessary buildings and land required for the provision of a sub-station in the Ovenden district, at an estimated cost of £7,894.

Hebden Bridge.—Bulk Supply.—The District Council has decided to ask the Yorkshire Electric Power Co. and the Halifax Corporation Electricity Department to quote terms for a bulk supply to Hebden Bridge, as the local works have reached the maximum output, and are insufficient to meet all the demands of the district.

Heysham (Lancashire).—Electricity Supply.—The Heysham Council and the Electricity Committee of the Morecambe Corporation were recently in negotiation with a view to Morecambe supplying electricity to Heysham either in bulk or in detail, but at a subsequent meeting of the Morecambe Committee, a letter was received from the Heysham Council stating that it was not deemed advisable or feasible for a scheme to be arranged for the time being.

Kendal.—Year's Working.—The engineer reports total receipts of £3,931 for the past financial year, leaving a gross profit of £336 and a net deficiency of £962.

Kettering.—Year's Working.—The accounts of the Council's Electricity Department for the past financial year show a total income of £40,632, as against £25,362 for the previous period. Working expenses, loan repayment and interest totalled £39,171, as against £25,380, leaving a net profit of £1,461, contrasted with a deficit of £18 for 1918-19.

Kingston-on-Thames.—Year's Working.—The Electricity Department reports a gross surplus of £12,702, and a net credit balance of £2,300, after payment of loan charges, &c. The output increased from 1,608,450 to 1,848,038 units, and a reduction of 1·064d. per unit was effected in the cost of generation.

London.—Hammersmith.—The Electricity Committee has put in a tender of £3,500 for one of the two 2,000-kw. turbo-alternators offered for sale by the Liverpool Corporation. This is to enable the undertaking to cope with the winter load, as the plant extensions, for which tenders have been invited, will not be completed in time.

The Council has arranged to provide an additional bulk supply of electricity to the Chiswick Electric Supply Corporation, subject to the receipt of official sanction.

Price Increases.—The following towns have adopted new scales of prices for electricity or have applied for sanction to revise charges :—Bedford, Bromley (Kent), Coventry, Haslingden, Maidenhead, Mansfield, Merthyr Tydvil, Rushden, Stamford, Todmorden, Wellingborough, and the towns supplied by the Isle of Wight Electric Light and Power Co.

Newport.—Extensions.—At a special meeting of the Corporation, a report recommending large extensions was adopted. The total cost is estimated at about £209,000, and some of the items are :—Turbo-alternator, condensing plant and switchgear, £67,530; boiler-house plant and buildings, £51,557; rotary converter and switchgear, £10,362; and mains and services, £61,655. It was stated that the expenditure would add an annual amount of £21,000 to the loan charges. The borough engineer is to confer with outside experts upon the question of utilising water from the River Usk for condensation and circulation purposes.

Maidenhead.—Loan.—The Town Council is applying for a loan of £10,000 for mains extensions.

Manchester.—Sale of Undertaking.—The Electricity Committee has agreed to accept £40,000 as the purchase price of that portion of the Heaton Norris electrical undertaking to be transferred to the Stockport Corporation in September, 1920, under the Stockport Extension Order, 1913; and, in addition thereto, the amount of any expenditure incurred by the Manchester Corporation in the area of Heaton Norris added to Stockport by the said order since March 31st, 1920.

Marsden (Yorkshire).—Electricity Supply.—The Council received a letter from the Electrical Distribution of Yorkshire, Ltd., intimating that that company intended to apply for a provisional order authorising it to supply electricity for public and private use within the Marsden area, and asking for the Council's approval. The clerk said the Council had been approached by the company previously, but the matter had been held up by the war. The company is being requested to send a representative to meet the Finance and General Purposes Committee.

Salford.—Restrictions on Supply.—Owing to the delay in obtaining delivery of generating plant, the Town Council announces that for the present it is necessary to restrict all additional supplies of electricity, and intending applicants are requested to hold over applications for additional supplies until next year.

South Africa.—Paarl.—At a meeting of municipal voters held in connection with the proposed extension of the electric lighting and power scheme, a resolution was adopted that the Town Council take immediate steps to develop the electrical installation as set forth in the new scheme of Mr. Hugh Purves, the municipal electrical engineer, which entails the expenditure of £71,434.

Spenborough.—Year's Working.—A statement of accounts for the past year's working of the electricity undertaking shows a profit of £383, as compared with a deficit of £1,625 in the previous year. It was reported that extensions were needed, and application is to be made for power to borrow £9,000.

Stoke-on-Trent.—Year's Working.—The accounts of the electricity undertaking for the past year show that the total income was £124,000, as compared with £81,000 in the previous year; the total expenditure was £75,000, against £60,000. The gross profit of £49,000 was divided up as follows :—Redemption of loans, £16,000; interest on loans, £12,000, leaving a net profit of £21,335. Out of this the Committee paid £500 out of revenue for changing over a number of meters from one place to another, and approximately £2,000 for new meters, a clear net profit of £18,886 remaining. After deducting the previous loss on the undertaking of £14,597, there was a credit balance of £4,289.

Sunderland.—Year's Working.—The annual report of the Corporation electricity undertaking states that in the year ended March 31st a credit balance of £12,830 was realised, nearly all of which it is proposed to apply in writing off debts on superseded plant. The total sales were 19,364,143 units, an increase of 4 per cent. The income for the year was £137,240, of which £34,149 was received for private lighting and heating, £81,558 for power, £17,261 for traction, and £3,337 for public lighting. Generation, repairs and maintenance costs were £71,754; distribution, £7,910; management and general expenses, £7,058. The balance carried to net revenue account is £46,522, and after writing over £12,000 off for superseded plant, £520 is left to be carried forward. The capital account shows a total expenditure of £588,141, the loans repaid amounting to £317,906, and loans outstanding to £267,564.

Todmorden.—Loan.—The Corporation is applying for sanction to borrow £42,000 for laying cables to distribute a bulk supply of electricity to be obtained from the Yorkshire Electric Power Co.

Tunbridge Wells.—Year's Working.—The total revenue accruing to the Electricity Department for the past financial year amounted to £27,477, and total working costs to £15,191. The interest and repayment on capital expenditure and income-tax amounted to the sum of £5,916, leaving a net profit on the year's working of £6,370. The result of the previous year's working was a loss of £27. The surplus has been allocated to the purchase of machinery, &c., which would otherwise be a capital charge, and the balance carried to working capital. The units generated during the year increased by 280,000.

West Bromwich.—Year's Working.—The total income of the electricity undertaking for the year ended March 31st, 1920, was £66,230, as against £53,887 for the previous year. Working expenses amounted to £48,876, leaving a gross profit of £17,354. Interest and redemption of loans absorbed £10,575, resulting in a surplus of £6,779.

York.—Extension Approved.—The Electricity Commissioners have intimated that the Corporation may proceed with the carrying out of the works at Linton Lock.

Sale of Plant.—The Electricity Committee has agreed to accept an offer for the purchase of two Willans-Crompton generating sets not now required at the works, for the sum of £775.

TRAMWAY AND RAILWAY NOTES.

Belfast.—Year's Working.—At the monthly meeting of the Corporation on the 1st inst., Lord Mayor Coates presiding, it was announced that the traffic revenue for the half-year ending March 31st, amounted to £545,480, and the total receipts to £545,348, being an increase of £139,242 and £139,047 respectively over the figures of the previous year. The working expenses showed an increase of £121,925. The balance carried to net revenue account was £169,476, an increase of £18,085. After meeting income-tax charges and allowances for depreciation and renewals there was a surplus of £36,150, as compared with £29,231 last year. The increase of wages stood at £2,000 per week, and if the advances granted had been in operation the whole 12 months, there would have been a deficit of £3,300. The city accountant's figures for 1921 showed an estimated deficiency of £21,000, and a recommended increase of wages would bring it up to £38,000. Certain changes in fares and stages were passed. It was admitted that the permanent way was in bad condition, and an expenditure of £400,000 would be necessary if some 20 miles of it was relaid.

Birmingham.—Electric Vehicles.—The Corporation has recently established a fleet of electric vehicles for collecting house refuse. Twenty-five were ordered, and 11 have been delivered, and are in full use. The delivery has been impeded owing mainly to the ironmoulders' strike, which held up the makers for castings. In a report to the City Council this week on the reorganised system, the salvage department states that it is economically impossible with horse haulage alone, and the institution of the 47-hour week, to deal speedily and satisfactorily with house refuse collection. These difficulties are now being overcome by the introduction of the electric vehicles, the areas already brought under the new system representing a total of 31,800 houses, and a population of 160,000. It is further stated that under the new system the city is being planned, and districts will be re-allotted to fixed depôts, and it is expected that when sufficient electric vehicles have been delivered, every house will be visited weekly. Tuition classes for electric vehicle drivers have been arranged so as to enable employés in the salvage department to qualify, and over 70 have taken the course of instruction. A steady flow of trained drivers will thus be ensured, and opportunities for promotion afforded to the existing employés.

Blackpool.—Renewal of Track.—The tramway tracks at Blackpool require to be relaid, and the cost of carrying out the work is £254,000. The reconstruction of the track in the Marton district will be commenced in October.

Bolton.—Extension.—The Tramways Committee has under consideration the extension of its already comprehensive system to Darcy Lever and Little Lever, in one direction, and to Westhoughton in another.

Burnley.—Year's Working.—The total revenue for the year ended March 31st, 1920, was £158,601, as against £124,213 for the previous period. Expenditure totalled £137,952, as against £95,940, leaving a gross balance of £20,649, compared with £28,273. The net result, after payment of income-tax and other charges, was a deficit of £2,096, which was taken from the reserve fund.

Colne.—Fares.—The Town Council has decided to apply to the Minister of Transport for an order permitting the statutory maximum charges of the tramway undertaking to be increased to an amount not exceeding 50 per cent., and also for an immediate order, on the ground of urgency, authorising an increase in the statutory maximum charges to 2½d. for two miles, 3½d. for three miles, and in workmen's fares to 1½d. for two miles, instead of 1d.

Loan.—Application is to be made to the Minister of Transport for sanction to borrow £1,115 for land on the Stanroyd Estate, acquired for the erection of a new tramway depôt.

Tower Wagon.—The Town Council has decided to purchase a petrol-electric-driven tower wagon for the tramway department, at an estimated cost of £1,250.

Doncaster.—Proposed Fare Increase.—The Town Council, sitting in Committee last week, decided to apply for an order under the Tramways (Temporary Increase of Charges) Act, 1920, giving power to the Council to increase the local tramway fares to an amount to be sanctioned.

Grimsby.—Electric Vehicles.—The Town Council has decided to apply to the Minister of Transport for sanction to borrow £9,500 to cover the cost of purchasing six electrically-driven vehicles for household scavenging and highway purposes.

Guildford.—Electrification Postponed.—The London and South-Western Railway Co. has decided to postpone the electrification of the Cobham and Leatherhead lines to Guildford. This decision is attributed by the directors to the abnormal increase in the cost of material, the refusal of manufacturers to give firm quotations and guarantee delivery, and "the impossibility of raising fresh capital while the present uncertainty as to the future of railways continues."—*Morning Post.*

Japan.—Mono-Rail Tramway.—To relieve the congestion of travelling in Tokio, and as an auxiliary to the municipal electric car service, several business men of the capital approached the Government for permission to build a mono-rail electric tramway over the rivers and canals in Tokio. Details since to hand show that the scheme proposes to start the line near Shimbashi, over the canals, thence over the Sumida River as far as Yoroibashi, near the Stock Exchange. The terminus will be Tabata, on the Government railway. Each car will be capable of accommodating 50 persons, and will be run at an average speed of about 25 miles per hour. The proposed company is to be capitalised at 15,000,000 yen. The estimated cost of building the line is about 1,630,000 yen per mile.—*Eastern Engineering.*

Lancaster.—Report on System.—Mr. A. R. Fearnley, M.Inst.A.E., who was called in to examine the whole traffic system of the city, has just presented his report. Since its inception the tramway system has only made a profit of £562, against a total loss of £36,189. Mr. Fearnley states that on one route—from the Castle Station to the Market—in 47 journeys only 69 passengers were carried, an average of 1·46 passengers per journey. On the return route 115 passengers were carried in 47 journeys—an average of 2·44. It is, therefore, recommended that this route be abandoned, and an annual saving of £1,100 is estimated. On certain other routes, Mr. Fearnley suggests the conversion of the existing double-deck cars to single-deck with a consequent reduction of *personnel* and an annual saving of £1,200. An increase and revision of fares is also recommended, existing charges being considered much too low, in view of the advance in working costs. The need for economy is to be impressed upon all employés to ensure that power consumption is reduced to a minimum, and that every fare is paid. The condition of the system is stated to be good, and Mr. Fearnley considers that in the interests of the public it is desirable to keep the tramcars running at least for a time, after making the suggested alterations and improvements, to see if the financial result permits the continuance of the system.

London.—L.C.C. Tramways.—The L.C.C. Highways Committee's report on the working of the tramways for the past financial year announces a total income of £4,295,846, as compared with £3,578,256 for 1918-19. The working expenses reached a total of £3,680,909, as against £2,858,414, leaving a gross surplus of £614,937, as against £719,842. After debiting loan charges, &c., and crediting rents and other receipts, the net result was a deficiency of £100,722. This deficit has been partly met by the general reserve and renewals funds, but a debit balance of £18,824 has to be carried forward to the next account.

Fare Reductions.—As the Metropolitan Electric Tramways Co. finds that the recent increases are causing a loss on certain routes, it has reduced a number of stages from 1½d. to 1d.

Tube Fares.—When the London Electric Railway Companies (Fares, &c.) Bill came before the House of Commons for the third reading, a motion for its recommittal was submitted on the ground that the Select Committee had not carried out its instructions regarding the fixing of fares to provide a fair return on capital. The motion was defeated, and the Bill read a third time.

Salford.—The motor 'bus service proposed to be instituted by the Tramways Committee will be one of the most ambitious and comprehensive in the whole of Lancashire.

Sunderland.—Year's Working.—The report of the Corporation Tramways Department for the year ended March 31st last, states that over 31¼ million passengers were carried, the receipts being £149,126 (22·4d. per car-mile), as compared with receipts of £118,029 in the previous year. There was a net balance on the year's working of £26,342. After providing for repayment of loans, renewals, new cars, &c., £5,000 is to be given in relief of rates, making a total sum of £77,027 disposed of in this manner. The reserve and renewals funds have credit balances amounting to £63,394. The total expenditure on capital account has reached £309,770.

TELEGRAPH AND TELEPHONE NOTES.

Chesterfield.—Time Signals.—The Corporation is giving notice to the Postmaster to terminate the agreement for time signals, and arrangements are to be made for erecting a wireless installation at the electricity works for receiving time signals in lieu thereof, at a cost of £35.

Scandinavia.—Telegraphic Communication with Russia.—Negotiations have been opened between the Store Nordeska Telegrafselskab and M. Litvinov, representing the Soviet Government, with a view to the re-establishment of telegraphic communication between Scandinavia and Russia. According to the *Berlingske Tidende*, the S.N.T. has at its disposal two cables, one *via* the Baltic, and the other *via* Sweden and Finland. Both these cables could be made ready for use in a short time. The Soviet Government has placed certain restrictions on companies' cables between Irkutsch and Pekin, and between Vladivostok and Nagasaki.—*Economic Review.*

South America.—New Telephone System.—The municipality of Girardot, in Columbia, has called for tenders for a telephone system, and according to the *T. & T. Age*, the contract is to be awarded on August 1st next.

Telephone Rates.—Coming Changes.—The Select Committee appointed to consider the revision of telephone rates held its first meeting on July 1st, and appointed Sir Edward Coates chairman. The Committee held its first public sitting on July 5th, and began by hearing evidence from experts in the Telephone Department of the Post Office. Sweeping changes in telephone charges were forecasted by Sir Evelyn Murray, Secretary of the Post Office. The Department, he explained, proposed to abolish flat rates and measured services and to adopt a uniform tariff on a message

rate basis. Increased rentals were suggested at £8 10s. for London, £8 for Birmingham, Liverpool, Manchester and Glasgow, and £7 10s. for the provinces generally, and the charge per call was to be 1½d. within a five-mile circle. While as a whole these charges were intended to produce a considerably increased revenue in order to wipe out the loss on the present rates—estimated at nearly £9,000,000 in the current year—Sir Evelyn intimated that the small user would benefit under the new system. With regard to public call offices, Sir Evelyn said that while the present rate of 3d. per call was not remunerative, it would be difficult to increase it, as the public would probably refuse to pay 5d., the charge which would be necessary in order to show a balance of profit.—*Daily Telegraph.*

Telephone System.—EXTENSION DELAYS.—The Postmaster-General, in a written answer to a question in Parliament, attributes the delay in providing new plant for telephone extensions to congestion at manufacturers' works. Every opportunity is being taken, he states, to extend the list of firms capable of meeting the Post Office requirements.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW, *in which the "Official Notice" appeared.*

OPEN.

Australia.—SYDNEY.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-KW. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

Atherton.—July 20th. Urban District Council. 150 yds. ·022, L.T., concentric, paper-insulated, lead-covered and steel-armoured cable. (See this issue.)

Brentford.—July 27th. Board of Guardians. Electric lighting installations in the offices, infirmary, &c. (July 2nd.)

Darlington.—July 16th. Electricity Department. One 5,000-KW. turbo-alternator and surface-condensing plant. (June 25th.)

Edinburgh.—July 13th. Corporation. Electric lighting installations for houses at Gorgie. The Town Clerk.

Grimsby.—August 12th. Electricity Department. Two water-tube boilers, economisers, fittings, fans, chimneys, &c.; one 3,000-KW. high-pressure turbo-alternator and condensing plant. (July 2nd.)

Hull.—July 12th. Electricity Department. One three-motor electrically-operated overhead travelling crane. (June 25th.)

Manchester.—July 13th. Tramways Committee. Tramway rail bonds (copper). Mr. J. M. McElroy, General Manager.

New Zealand.—July 31st. Waikato Electric Power Supply. Delivery, c.i.f. Auckland, of 2,400 pin insulators, suitable for a line operating at 66,000 volts between phases. Tenders to Secretary, Public Works Tenders Board, Government Buildings, Wellington.

Nuneaton.—July 31st. Electricity Department. One 500-KW. rotary converter transformer and accessories. (July 2nd.)

Portsmouth.—July 20th. Tramways Committee. 1,000 tons steel girder tram rails; 20 tons steel fish plates; 5 tons fish bolts; 30 tons wrought-iron tie bars. (July 2nd.)

Preston.—Tramways Committee. Converting plant. (July 2nd.)

Warrington.—July 13th. Electricity and Tramways Committee. Two 6,000-KW. turbo-alternators. (June 18th.)
August 10th. Electricity and Tramways Committee. Coal elevator and conveyor. (See this issue.)

CLOSED.

Australia.—MELBOURNE.—City Council. Accepted :—
Two 2,000-KW. rotary converters for Little Queen Street sub-station, £21,392; switchgear for same, £9,766; switchgear for switch house, Spencer Street, £7,677.—Met.-Vickers Electrical Co., Ltd.
Switchgear for various stations, £10,384.—Ferguson, Pailin & Co., Ltd.
Six 250-K.V.A. transformers, £3,490.—Johnson & Phillips, Ltd. —*Tenders.*

SYDNEY.—City Council. Recommended. Consumers' electricity supply meters :—
A.C. meters, £11,709.—Edison Swan Electric Co., Ltd.
D.C. meters, £4,000.—Noyes Bros., Ltd.

P.M.G.'s Department, N.S.W. :—
200 secondary line switches; 20 master switches (primary); and 200 meter relay sets, for City North Automatic Exchange, £617; one 100 line automatic unit and associated equipment, Burwood Automatic Exchange, £994.—Automatic Telephones (Aust.), Ltd.
100-line and cut-off relays, Petersham Telephone Exchange, £195.—Western Electric Co. (Aust.), Ltd.
One 100-line automatic unit and associated equipment, Vaucluse Automatic Exchange, £994.—Automatic Telephones (Aust.), Ltd.

P.M.G.'s Department, Victoria. The following tenders have been placed :—
10 tons of 100 lb. copper wire, £1,660.—Australian Metal Manufacturers, Ltd.

N.S.W. Railway and Tramways Department :—
Two 2,500-KW. turbo-alternators, with condensing plant complete.—English Electric Co., of Australia, Ltd.
Three miles lead-covered L.T. cable.—Noyes Bros. (Sydney), Ltd.
14 miles lead-covered telephone cable.—Western Electric Co. (Aust.), Ltd.

N.S.W. Public Works Department :—
For Cordeaux dam. Two electric derrick cranes (Australian manufacture), £2,460.—J. E. Toole & Co.
Three single-phase wattmeters (testing), £328.—Noyes Bros. (Sydney), Ltd.
2,500 straight pin-type insulators, 2,000 square disks, 1,600 strain-type insulators, £16,581.—Australian General Electric Co., Ltd.—*Tenders.*

Automatic Telephones.—In our last issue, under "Government Contracts," we regret that the name of the successful tenderer for the Fleetwood telephone exchange was incorrectly given; it should read "Relay Automatic Telephone Co., Ltd." We understand that in addition to this order, the company has nine other orders in hand for public exchange systems and a large number of private ipstallation orders.

Belgium.—Four home firms competed for the supply of two electric cranes for the docks at Antwerp. The lowest tender for the 30-ton crane was that of Messrs. Pittevil & Co., Brussels, whilst the lowest offer of a 10-ton crane was that of La Société des Appareils Electriques et Scientifiques, Brussels, the prices being respectively £23,890 and 659,682 francs.
The municipal authorities of Voroux-Goreux (Province of Liége), recently invited tenders for the concession for the supply of electricity for lighting and power purposes in the town. Not a single tender was received.

Bury.—Town Council. Accepted :—
8/10,000-KW. set.—Fraser & Chalmers, Ltd.
Steam pipes, valves, &c.—J. Spencer.
Exhaust pipes and castings.—J. Wolstenholme.

Dundee.—Corporation. For Carolina Port station. Accepted :—
The Clyde Structural Iron Co., Ltd., £30,187.—Steel work.
Babcock & Wilcox, Ltd., £10,450.—Pipe-work.

London.—ISLINGTON.—Lighting Committee. Recommended :—
Two 20-H.P. motors, £589; four 7½-H.P. motors, £649 (Century motors).—Swedish General Electric Co., Ltd.

HAMMERSMITH.—Electricity Department. Recommended :—
Three improved CO_2 recorders, £97.—W. R. Patents, Ltd.
Time switches, £407.—Venner Time Switches, Ltd.

MARYLEBONE.—Electric Supply Committee :—
10-ton crane for Aybrook Street Station, £306.—Herbert Morris, Ltd.

On February 12th last the Council accepted the tender of Messrs. Herbert Morris, Ltd., for a three-motor crane, capable of lifting 60 tons, for £4,815. Owing to the intervention of the Electricity Commission, instructions could not be given to Messrs. Morris to proceed with the work, and they have now intimated that not only has the price increased to £5,495, owing to the variations in cost of material, &c., but a difficulty has arisen in regard to delivery, particularly of the motors for operating the crane. The Electric Supply Committee has instructed Messrs. Morris to proceed, leaving open the question of the motors until further inquiries are made.

SHOREDITCH.—Standing Committee recommended :—
One Roto Feed Water Pump, £510.—G. & J. Weir.

WHISTON STREET EXTENSION, E.H.T. AND L.T. SWITCHGEAR.
Nine tenders have been received as follows :—

	Whiston Street Station.	Coronet Street Station.	Delivery in weeks.
Met.-Vickers Elec. Co., Ltd. ...	£9,740	£1,464	Coronet Street 38 Whiston Street 56
B. T. H. Co., Ltd.	9,510	1,570	46-52
Bertram Thomas	10,150	2,020	52
Switchgear & Cowans, Ltd. ...	10,964	1,490	48
Whipp & Bourne, Ltd., ...	10,740	2,230	50-60
New Switchgear Const. Co., Ltd.	10,865	1,630	52
Ferguson, Pailin, Ltd.	10,052	1,525	45
General Electric Co., Ltd. ...	9,861	2,050	45-52
A Reyrolle & Co., Ltd.	10,610	1,480	45-52

The Committee recommend the acceptance of the tenders of Met.-Vickers Electrical Co., at £1,464 for Coronet Street switchgear, and Brit. Thomson-Houston Co., at £9,510 for Whiston Street switchgear.

Manchester.—Electricity Committee. Recommended :—
Supplying and installing 33,000-volt underground feeder cable, from Stuart Street to Droylsden.—W. T. Glover & Co., Ltd.
Static transformers for 12 months.—Ferranti, Ltd.
For the first section of the overhead work for the supply of electricity to the Blackley Estate.—Twiss Eng. & Elec. Transmission Co., Ltd.

Salford.—Electricity Committee. Recommended :—
Cable, £625.—Macintosh Cable Co., Ltd.
Metal plates on doors of oil-switch cubicles, £154; two 2,500-K.V.A. transformers, £1,900.—Met.-Vickers Electrical Co., Ltd.
Steel, steam and exhaust piping, for 5,000 KW. turbo-alternator set, £507.—Babcock & Wilcox, Ltd. Piping for same, £273.—Aiton & Co., Ltd.
Meters.—Met.-Vickers Electrical Co., Ltd.; Reason Mfg. Co., Ltd.; Ferranti Ltd.; Chamberlain & Hookham, Ltd.

FORTHCOMING EVENTS.

Institution of Electrical Engineers (Summer Meeting at the Western Centre at Cardiff, from July 13th to 16th).

Roentgen Society.—Thursday, July 15th. At University College, Gower Street, W.C. At 9 p.m. Address by Dr. W. D. Coolidge, chief of the research laboratories of the General Electric Co., Schenectady, U.S.A.

NOTES.

Electricity Supply Rifle League.—The following are the results and positions of clubs at the end of the first half of the season in connection with the above League Competition:—Brompton and Kensington, 534—Hampstead, 519; Metropolitan, 565—Brompton, 542; Shoreditch, 577—Brompton, 543; Shoreditch, 575—Hampstead, 557.

—	Shot.	Won.	Lost.	Scores For.	Scores Against.	Points.
Metropolitan ...	8	8	0	4,559	4,307	16
Shoreditch ...	8	7	1	4,592	4,406	14
Central	8	6	2	4,512	4,381	12
City Co.	8	5	3	4,553	4,273	10
Hackney... ...	8	4	4	4,335	4,344	8
Hampstead ...	8	2	6	4,238	4,379	4
Brompton ...	8	2	6	4,313	4,388	4
St. James's ...	8	1	7	4,230	4,428	2
Poplar	8	1	7	4,010	4,436	2

Educational.—UNIVERSITY COLLEGE, LONDON.—The following awards have been made in the Faculty of Engineering:—

Goldsmid Entrance Scholarship.—L. W. Ball, Royal Grammar School, Guildford: F. R. Kay, St. Paul's School (divided).

Archibald P. Head Medal and Prize.—W. Hudson.

Jews' Commemoration Scholarship (renewed for second year).—H. P. Porter.

L. F. Vernon Harcourt Prize.—E. F. Anderson, R. W. Taylor (div.).

Engineering Diplomas: Civil, Municipal, and Mechanical.—E. F. Anderson, W. Hudson (with distinction), R. W. Taylor.

Civil: A. Calmus.

Civil and Municipal: A. A. Clements, R. G. Leembruggen.

Mechanical: F. W. Jones, E. N. Varian.

Electrical: T. S. Pick.

Service Notes.—Lieut. J. R. Lang-Hyde, Tyne Electrical Engineers, has been appointed a lieutenant in the Reserve of Officers of the Territorial Army, with effect from the 26th ult., Lieut. H. S. Craig has resigned his commission in the London Electrical Engineers from the 26th ult., and retains the rank of lieutenant. Engineer Commander H. S. Briggs, O.B.E., Royal Navy, has been appointed to Bathurst wireless station, Gambia, West Africa. The wireless station at Bathurst—which is the chief town of Gambia—is one of the new stations the completion of which is being hurried on, some £16,000 being allotted for expenditure on it. Warrant Electrician H. B. Serridge has been appointed to the cruiser *Conqueror*; Warrant Electrician D. Tanguy to the light cruiser *Dido*, both temporarily for R.F. exercises.

Garlearini's Rotating Arc Lamp.—The inventor of this lamp seeks to approximate as closely as possible to the theoretical point source of light, fully utilised and automatically maintained. He uses, according to the *Revue Générale de l'Electricité*, a cored carbon rod of much the ordinary type as positive electrode, which provides the luminous crater. The non-luminous negative electrode is a metallic ring surrounding and presenting its inner edge towards the crater; the ring is cooled by circulating water or spirit. By the action of the magnetic field of a coil the arc between the crater and the inner edge of the ring is caused to rotate at 500 to 3,000 R.P.M. The rotation is too rapid to be distinguished by the eye, and the arc only appears as a highly incandescent spot surrounded by a bluish halo. Only the positive electrode burns away and need be moved; the regulation is controlled by the dilatation of a metal strip, and is independent of the arc current and voltage.

Electrically-Welded Ship. — The first electrically-welded vessel built in Britain ran speed trials in the Firth of Clyde on Friday. The new vessel, named the *Fullagar*, was built by Messrs. Cammell, Laird & Co., Birkenhead. The vessel had on board a distinguished party of engineers and others interested in the new method of construction. The ship is a 500-ton coaster, and in the construction of the hull, riveting has been entirely dispensed with, electric welding on the "quasi-arc" method taking its place.

Submarine Camera.—The submarine camera, which was supplied by Messrs. Siebe Gorman & Co. for taking photographs under water for war purposes, may have some useful peace applications. The apparatus is composed of three gun-metal castings bolted together, giving a height of 4 ft. 9 in., and a diameter of 3 ft. 4 in. The upper and lower castings are each formed with four watertight chambers, in each of which a mercury vapour lamp, giving 3,000 C.P., or 24,000 C.P. in all, is installed. In the chambers composing the middle castings are housed the lamp resistances and the cameras. The lamps used are of the silica type of Westinghouse Cooper-Hewitt design. The mercury vapour is contained in a quartz vessel, having an overall length of about 9 in. The lamps operate in parallel on a D.C. supply of 200 volts at a current consumption of 3½ amperes, and the photographic effect, it is claimed, is equal to that of other lamps using a very much higher current. The lamps have been made as simple as possible, so as to avoid all unnecessary complications, the tilting to start their action being effected by means of special levers actuated by rods on the outside of the box. These rods and the leads to the lamps pass through stuffing boxes. The cameras are of a special box type, and are fitted with behind-lens shutters, which are electrically controlled.

Appointments Vacant.—The University of London Senate is inviting applications for the University Chair of Radiology, tenable at Middlesex Hospital Medical School, at £1,000 per annum; assistant inspector of wireless telegraphy (£200+), for the General Post Office. See our advertisement pages to-day.

Fatality.—*The Times* states that a 16-year-old lad named Robert John Mort, was helping a smith to shoe horses at the Cynon Colliery, Port Talbot, when he touched a live wire and was killed.

INSTITUTION NOTES.

Junior Institution of Engineers.—On June 30th a dinner was held at the Monico Restaurant, London, in celebration of the 36th anniversary of the foundation of the Institution. Sir Eustace H. Tennyson d'Eyncourt, K.C.B., president, was in the chair. After the toast of "The King," Mr. A. Richardson, M.P. (vice-President), proposed "The Institution," which he said always retained the characteristics of "juniorhood"—virility and courage—and showed the way to the more conservative institutions. The first generation of scientifically trained engineers was now taking its place in industry, and the great scientific institutions should take note of the fact and adapt themselves to the new conditions; membership was a hall-mark of scientific ability, and they must see that the status conferred by it was maintained at a high level. The Junior Institution, with many branches at home and abroad, was decentralising, but gaining strength thereby. Mr. B. E. Dunbar Kilburn, chairman, in responding, said that during his year of office, the membership had passed 2,000, and the present rate of growth made a fresh record. He had visited nearly all the local sections, and everywhere found the same keenness and enthusiasm as at headquarters.

LORD WEIR OF EASTWOOD (president-elect), proposing "Naval Architecture," referred to the great part which it had played under the direction of their president, on and under the sea, in the air, and on the land. Mr. W. H. Whiting, C.B., responded, and emphasised the importance of the registration of engineers, as well as that of the education of apprentices.

MR. W. J. TENNANT (vice-president) proposed "Kindred Institutions," to which Capt. H. Riall Sankey, R.E., C.B.E., Mr. C. H. Wordingham, C.B.E., and Mr. F. Merricks, C.B.E., responded. Capt. Sankey said the Civil Engineers were going to call a conference to discuss the best course to follow in promoting the Registration Bill; Mr. Wordingham urged that engineers should all act together, and present a united front, and referred to the help received from that Institution by the I.E.E. in establishing its "Informal Meetings"; Mr. Merricks, also supporting the principle of registration, asked Capt. Sankey to call a meeting of the various institutions, to form the nucleus of an engineering council, and the latter stated that on July 5th such a meeting would take place to discuss Whitley Councils, which he hoped would be the beginning of a permanent conference.

MR. W. A. TOOKEY (past chairman and hon. secretary) proposed "The President," and expressed the readiness of the Juniors to help the Seniors in making their weight felt in the councils of the nation. The toast was drunk with musical honours, and Sir Eustace, responding, remarked upon the extraordinary zeal with which the J.E.'s did their work.

During the evening a musical and ventriloquial programme was performed, and the proceedings were very enjoyable.

Institution of Electrical Engineers.—On Thursday last week the Annual Conversazione of the Institution was held at the Natural History Museum, South Kensington. Mr. Roger T. Smith, president, and Mrs. Roger Smith, with members of the Council, received the guests, who numbered, in all, over 1,300, and included Sir John Beall, Sir A. Whitten Brown, K.B.E., The Hon. Sir J. A. Cockburn, M.D., K.C.M.G., Sir G. K. Elphinstone, K.B.E., Sir Lazarus Fletcher, F.R.S., Col. Sir T. H. Holdich, R.E., K.C.M.G., Admiral of the Fleet Sir H. B. Jackson, R.N., G.C.B., K.C.V.O., Rear-Admiral F. C. Learmouth, C.B., C.B.E., Mr. A. Page, Major-General Sir R. M. Ruck, K.B.E., C.M.G., and the Right Hon. E. Shortt, K.C., M.P., as well as Col. R. E. Crompton, C.B., Mr. W. M. Mordey, Sir John Snell, Dr. G. Kapp, and Mr. C. H. Wordingham, C.B.E. (past presidents), Mr. L. B. Atkinson, Dr. W. H. Eccles, Sir James Devonshire, K.B.E., Mr. A. P. M. Fleming, Dr. C. C. Garrard, Messrs. J. S. Highfield, W. B. Hird, J. F. Nielson, G. W. Partridge, C. C. Paterson, O.B.E., W. M. Selvey, and P. D. Tuckett (members of Council), and Mr. P. F. Rowell (secretary).

During the evening the String Band of the Royal Engineers, under Lieut. Neville Flux, F.R.A.M., performed a programme of music in the Central Hall, and a concert party, including a string quartet, gave two performances in the Reptile Gallery; demonstrations of wireless telephony in the Shell Gallery, with the aid of loud-speaking telephones, formed a novel feature of the entertainment, and refreshments were served in the usual places. In spite of the weather, which was by no means clement, the function was marked by the customary success, and many old friends availed themselves of the opportunity to forgather in such pleasant surroundings.

Roentgen Society.—A meeting of the Roentgen Society will be held at University College, Gower Street, W.C. 1, on Thursday, July 15th, at 9 p.m., when an address will be given by Dr. W. D. Coolidge, chief of the research laboratories of the General Electric Co., Schenectady, U.S.A. Members of the Institution of Electrical Engineers are cordially invited to the meeting.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The *Melbourne Age* states that Mr. W. H. STONE, chief electrical engineer of the Victorian (Australia) Railway Department, is retiring, having reached the age limit, and it is understood Mr. H. P. Caldwell, assistant electrical engineer, will be appointed to the position.

Acting on medical advice, Mr. DUDLEY DOCKER has resigned his seat on the boards of Vickers, Ltd., the Metropolitan Carriage, Wagon, and Finance Co., and the Patent Shaft and Axletree Co.

Mr. W. G. WATSON, managing director of W. G. Watson & Co., Ltd., of Sydney, is now in this country purchasing electrical and other goods and arranging new representations in Australia. British manufacturers can communicate with him c/o The Editor, The ELECTRICAL REVIEW.

Mr. E. W. SUDLOW, on the occasion of his marriage, has been presented by the management and staff of Fuller's United Electric Works, Ltd., Woodland Works, Ilford, with a silver tea service.

Swindon T.C. has increased the salary of the general manager of the electricity and tramways department to £460 a year, and that of the electrical engineer to £450, both as from March 31st last.

An interesting function is being arranged at Glasgow in honour of Messrs. W. W. LACKIE and ARCH. PAGE on their recent appointments as Electricity Commissioners. The presentations will take the form of illuminated addresses enclosed in oak caskets.

Prof. Sir JOHN CADMAN, K.C.M.G., D.Sc., University of Birmingham, Mr. W. B. HARDY, Soc.R.S., Gonville and Caius College, Cambridge, and Prof. SYDNEY YOUNG, D.Sc., F.R.S., Trinity College, Dublin, have been appointed by an Order of Council dated June 24th, 1920, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research

We learn from Société Anonyme Brown, Boveri & Cie. of Baden, that Mr. A. C. EBORALL, who for many years has been in charge of their interests in Great Britain, has recently been appointed an executive director of the company.

Obituary.—MR. E. T. WARD.—The death has occurred from a sudden seizure of gastritis, followed by peritonitis, of Mr. E. T. Ward, a Derbyshire electrician in the employ of the Great Central Railway Co. He was only 42 years of age.

LORD DOWNHAM.—We regret to report that Lord Downham (Mr. Hayes Fisher, as he was known before he became a Peer) passed away on July 2nd from heart failure after an operation. Lord Downham, who was 67 years of age, had been for many years connected with the financial side of the electrical supply industry. He was chairman of the Westminster Electric Supply Corporation, and a director of the Central Electric Supply Co.

MR. HENRY GREENWOOD.—We regret to record the death, at the age of 83 years, of Mr. Henry Greenwood, a director of Greenwood & Batley, Ltd., of Leeds.

HERR CARL DIHLMANN.—The death is announced from Berlin, at the age of 63 years, of Herr Carl Dihlmann, one of the directors of the Siemens-Schuckert Co., of that city. The deceased was an authority on works organisation.

MR. C. MCLEAN.—The funeral took place last week of Mr. Charles McLean, chief electrician for many years at Lord Ellesmere's collieries and workshops in Walkden and adjoining districts. The deceased gentleman, who was 69 years of age, had originated many improvements in Lord Ellesmere's industrial electrical installations. He died suddenly whilst on a visit to Blackpool.

Long Transmission Lines.—According to Mr. P. Bunet, in the *Revue Générale de l'Electricité*, 500 km. and 100,000 volts per phase represent the limits of transmission distance and pressure with lines of the ordinary construction. The author then shows that by using the so-called "quarter-wave" construction, lines of 1,000 to 1,500 km. become a practical possibility. Such a line has the usual two conductors for single-phase and three for three-phase, but frequency, capacity and inductance have such values that at no load the line is in resonance. The current must be maintained nearly constant at the generating end, and constant voltage will be received at the other, with reasonable regulation, efficiency and conductor cost. The theory is explained, a parallel being drawn with the effect of sound waves in a tube. It is pointed out that in the case of such long lines as those now considered the speed of propagation of electricity, hitherto safely negligible, begins to assume importance. An example is worked out of a line 1,200 km. long at 50 periods, transmitting 75,000 KW., and tables are given of efficiencies at various loads and power factors, and of pressure distribution throughout the line. Such lines would only be practicable for the transmission of power in bulk to the distant point without services *en route*. With regard to the problem raised by the necessity for constant current generators, the author refers to the possibilities of collector type alternators.

NEW COMPANIES REGISTERED.

Essex Light Railway and Property Co., Ltd. (168,626).—Private company. Registered June 28th. Capital, £10,000 in £1 shares. To construct and work light railways or tramways in Essex or elsewhere. The subscribers (each with one share) are: A. D. Holmes, 40, Ludgate Hill, E.C.4, incorporated accountant; T. F. Wills, 44, Wavendon Avenue, Chiswick, managing clerk. The first directors are not named. Solicitor: C. Greenwood, 1, Mitre Court Buildings, E.C.

Yorkshire and District Electric Lamp Repairing Co., Ltd. (168,647).—Registered June 28th. Capital, £30,000 in £1 shares. To take over a certain licence granted or to be granted by the Allies Electric Lamp Repairing Co., Ltd., to C. G. Gordon-Young, and to carry on the business of manufacturers, importers, exporters and repairers of and dealers in electric lamps of all kinds, electric light and general engineers, &c. The first directors are: H. J. M. Cockayne, 42, Kingfield Road, Sharrow, Sheffield; A. S. Lee, 10, Taptonville Road, Sheffield; A. C. Davy, 10, Oak Park, Manchester Road, Sheffield; C. G. Gordon-Young, Four Acres, Oughtibridge, near Sheffield; D. W. Hogan, 6, Sinclair Road, Kensington, W.; A. W. C. Bower, Wortley, near Sheffield. Minimum cash subscription, £1,000. Qualification, £100. Registered office: 70, Queen Street, Sheffield.

Midland Counties Electrical Engineering Co., Ltd. (168,549).—Private company. Registered June 24th. Capital, £3,000 in £1 shares. To take over the business of electrical engineers and contractors carried on at Smethwick as the Midland Counties Electrical Engineering Co. The subscribers (each with one share) are: W. H. Baker, The Elms, West Smethwick, clerk; C. F. M. Skinner, 36, Arden Road, Handsworth, Birmingham, clerk. The first directors are not named. Registered office: 136, Sandon Road, Smethwick, Staffs.

Thos. Webb & Sons, Ltd. (168,582).—Private company. Registered June 25th. Capital, £100 in £1 shares. To carry on the business of manufacturers, importers and exporters of and dealers in glass, electric lamp bulbs, tubing and rod, bulbs for miners' lamps and wireless telegraphy, &c. The subscribers (each with one share) are: D. D. Smith, 11, Finsbury Park Road, N.4, solicitor; G. W. Waspe, 325, Hertford Road, Waltham Cross, Herts, clerk. The subscribers are to appoint the first directors. Solicitor: C. W. Austin, 6, Austin Friars, E.C. Registered office: 6, Austin Friars, E.C.

Castleton Electric Co., Ltd. (168,622).—Registered June 28th. Capital, £125,000 in £1 shares (50,000 6 per cent. cumulative preference). To carry on the business of electricians, electrical and mechanical engineers, dealers in electricity, motive power and light, switchgear makers, &c., to acquire all the issued shares of Whipp & Bourne, Ltd. (incorporated in 1915), and to adopt an agreement with S. Whipp, C. W. D. Bourne, F. Whipp, R. Walker, E. Tweedale and L. Tweedale. The first directors are: S. Whipp, Pilstone, Llandogs; C. W. D. Bourne, Roche Hill, Rochdale; F. Whipp, Bamford Cottage, Rochdale; R. Walker, Kingswood, Rochdale; E. Tweedale, Rhyddings, Rochdale; L. Tweedale, Beaumonds, Rochdale. Minimum cash subscription, £5,000. Solicitor: J. A. Hudson, The Butts, Rochdale.

Seal Co. (London), Ltd. (168,953).—Private company. Registered June 2nd. Capital, £1,000 in £1 shares. To manufacture, install and deal in electrical, chemical or electro-chemical or mechanical and magnetic, galvanic and other articles and apparatus, and to adopt an agreement with R. S. Atherstone, F. A. Fraser and F. H. Brewerton. The first directors are: F. H. Brewerton, 370, High Road, Willesden Green, N.W.; R. S. Atherstone, 38, Cossington Road, Westcliff; F. A. Fraser, 370, High Road, Willesden Green, N.W. Solicitor: G. O. White, 31, Great James Street, Bedford Row, W.C.

Watt Motors, Ltd. (168,712).—Private company. Registered June 30th. Capital, £25,000 in £1 shares. To carry on the business of marine, mechanical, civil, electrical, steam, gas, ventilating and hydraulic engineers, manufacturers of motors, tools, &c. The subscribers (each with one share) are: C. W. King, Pentre Gwylin, Llanishen, shipowner; G. St. J. Day, 83, Grove Park, Camberwell, S.E., electrical engineer. The first directors are to be appointed by the subscribers. Registered office: Premier House, 150, Southampton Row, W.C.

Woodcrow General Mechanical and Electrical Heating, Engineering Co., Ltd. (168,737).—Private company. Registered July 1st. Capital, £3,000 in £1 shares. To take over the business carried on at High Street, Stourbridge, under similar name, and to adopt an agreement with A. Pasfield. The first directors are: A. Pasfield, 118, High Street, Brierley Hill, mechanical and consulting engineer; E. Crowther, 8, Hagley Road, Stourbridge, mechanical and consulting engineer; T. R. Atkinson, Cairngorm, Ilfracombe, ropemaker. Solicitor: T. F. Bache, Lombard Street, West Bromwich.

Electric Brass Wares, Ltd. (168,534).—Private company. Registered June 24th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical wires, cables and flexible cords for lighting, power, telephone and wireless works, automobiles, high and low tension cables, wires for dynamos, motor instruments and accessories for lighting, power, telephones, aeroplanes, automobiles and motor cycles, &c. The first directors are: F. C. Blackwell, The Allmands, Great Crosby, Lancs.; A. B. Gregson, 8, Wellesley Terrace, Princes Park, Liverpool; J. Roberts, 15, Calderstones Road, Liverpool. Secretary: T. E. A. Killip. Solicitor: J. Roberts, 5, Harrington Street, Liverpool. Registered office: 21, Tempest Hay, Liverpool.

Stewart Thomson & Patrick, Ltd. (168,596).—Private company. Registered June 25th. Capital, £3,000 in £1 shares. To take over the business of an electrical and mechanical engineer carried on by S. R. Thomson at Palace Chambers, 21, Victoria Street, Liverpool, as "Stewart Thomson & Son." The first directors are: S. R. Thomson (managing director), 11, Mount Stuart Square, Orrell, Bootle, Liverpool; T. A. Patrick, 35, Bank Street, Bootle; R. D. Kilgour, 36, Sydenham Avenue, Sefton Park, Liverpool; E. R. Patrick, 33, Bank Street, Bootle. Solicitor: J. E. M. Crowther, 23, Abingdon Street, Westminster. Registered office: 10 and 12, Hart Street, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Portable Electric Motors (1919), Ltd.—Debenture dated June 16th, 1920, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: D. J. H. Cunnick, F. Eley and A. J. Hopewell, 15, Bishopsgate, E.C.

British Mica Co., Ltd.—Particulars of £1,500 debentures authorised by resolutions of April 1st and May 6th, 1920, amount of present issue £700. Property charged: the company's property, present and future, including uncalled capital. No trustees.

James Keith & Blackman Co., Ltd.—Satisfaction in full on June 16th, 1920, of debentures dated December, 1901, securing £1,000. Also issue on June 22nd, 1920, of £1,160 debentures, part of a series already registered.

G. Weston & Sons, Ltd.—Particulars of £999 debentures authorised June 11th, 1920, whole amount issued. Property charged: the company's undertaking and property, present and future, including uncalled capital. No trustees.

Wellingborough Electric Supply Co., Ltd.—Debenture dated June 16th, 1920, to secure all moneys due or to become due from the company to mortgagees, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Northampton Electric Light and Power Co., Ltd. Also issue on same date of £700 debentures, part of a series.

Ozonair, Ltd.—Satisfaction in full on May 12th, 1920, of charge dated May 24th, 1918, securing all moneys due or to become due from the company to bankers.

Engineering Components, Ltd.—Debenture dated June 18th, 1920, to secure £1,800, charged on the company's undertaking and property, including uncalled capital. Holder: C. Gordon, 16, Priory Mansions, Drayton Gardens, S.W.

Hindhead and District Electric Light Co., Ltd. (75,361).—Capital, £30,000 in £1 shares. Return dated June 22nd, 1920. 25,000 shares taken up. £14,500 paid. £10,500 considered as paid. Mortgages and charges, £4,450.

CITY NOTES.

General Electric Co., Ltd.

The net profits for the year ended March 31st, 1920, amounted to £630,143, as compared with £480,828 in the previous year. Adding the amount brought forward £141,502, there is a total of £771,646. After deducting debenture stock interest £8,000, depreciation £85,329, grants to dependants of men on active service and contribution to pension fund £6,766; 6½ per cent. dividend on "A" preference shares £107,626; transferred to reserve account £150,000, there is an available balance of £413,923. A dividend of 10 per cent. per annum, free of income tax, on the ordinary shares will require £122,500, and a further grant of £40,000 is made to superannuation trust fund, leaving to be carried forward (subject to excess profits duty) £251,423. The results are, in the opinion of the directors, most satisfactory, especially as they have been obtained during a year of reconstruction. The capital employed during the year was nominally three million pounds, but considerable credit was placed by the bank at the disposal of the company. The new issue made by the company in March, 1920, affects the year under review only in so far as a large part of it has been used to repay the bank for the advances it had made, which, up to March 31st, were employed in the development of the following assets appearing in the balance sheet: Approximate addition to—Freehold land and buildings, £200,000; Kingsway expenditure, £40,000; plant and machinery, £100,000; excess of trade debts over liabilities, £600,000; stock in trade, £300,000; trade investments, £450,000; total, £1,690,000. From the nature of this expenditure, it is apparent that a considerable proportion is not yet productive, mainly on account of the slow progress of essential building operations. The latter include erection of large telephone and ebonite works at Coventry, extension of engineering shops and new buildings for switchgear works at Witton, new administration buildings and club buildings at Witton, extensions to the Lemington glass works, Osram lamp works, and to the turbo works at Erith, and finally the completion of the company's building in Kingsway. The last is becoming daily more necessary, as the company, in consequence of its growth, is at present compelled to carry on its administration in London in 28 different buildings. The company's works are fully employed and, to judge by orders in hand, they are likely to remain so throughout the coming financial year. Independently of its factories, the company has now established in the United Kingdom 31 sales branches and depots; the overseas branches and depots number fifteen. The number of employees exceeds 15,000; a considerable addition is anticipated as soon as the works in process of building are completed. The contributory pension scheme came into effect on January 1st this year, and has met with a gratifying response from the company's employés. The annual cost of this scheme to the company will approximate £20,000. Almost all the company's allied and subsidiary enterprises continue to be satisfactory, the notable exceptions being some small supply companies, such as Maderia, Frinton, and Macclesfield, which have all suffered through conditions created by the war. Mr. H. P. Wells having accepted a position of greater responsibility with the company, the assistant secretary, Mr. L. C. Gamage, has been appointed secretary. Owing to the death of Mr. William Warburton, one of the trustees for the debenture stock holders, it is proposed to appoint Mr. Edward Manville, M.P., as a trustee in his place. Annual meeting, July 13th.

Anglo-Portuguese Telephone Co., Ltd.

The report for 1919 states that the average rate of exchange for the year was 28 13/16d., as compared with 30½d. for the previous year. The capital expenditure amounted to £39,006, as compared with £28,927 for 1918. An issue of 250,000 new ordinary shares of £1 each was made in December last at par. The profit and loss account shows a gross income of £109,313 (against £103,957), of which operating, management, and general expenses absorbed £76,238 (against £73,779), and royalties to the Portuguese Government £3,277 (against £3,107), leaving a gross profit of £29,797 (against £27,071). After payment of income tax £2,768, providing for debenture interest £3,590, and sinking fund £2,005, and writing off £9,965 (being one-third) of the expense attending the issue of extension debenture stock and new ordinary shares, the amount for disposal (including £8,207 brought forward) is £19,675. The directors recommend a further dividend of 4 per cent., less tax, making 7 per cent. for the year, leaving a balance of £8,828 to be carried forward. Owing to the persistent advance in wages and the greatly enhanced cost of material of every kind, says the *Financial Times*, the company's profits had recently undergone serious contraction, but the Portuguese Government has just authorised a substantial increase in the company's charges as from June 15th, 1920.

Anglo-Argentine Tramways Co., Ltd.

Sir George Touche, Bart., presiding at the annual meeting, referred to the death of the late chairman, Mr. J. B. Concanon, and to the rearrangements of the board consequent thereupon, and upon the removal of German elements from the directorate owing to the war. No German element in the company would be acceptable to the British, French, or Belgian shareholders. For the plain citizen, the war must blunt the edge of intimacy for this generation at least. While the dividends were still heavily in arrear their position was not nearly so deplorable as a year ago, and there was every promise that a reasonable prosperity awaited them in the early future. The abnormal conditions under which they had been working for some years continued to press hardly upon them during the year, but he hoped that that period marked the close of a very disagreeable era in the company's history. The main adverse conditions were the excessive cost of electric energy caused by the dearness of fuel and freights, the need for increased wages to meet the higher cost of living, and the reduction in the number of hours of work. They had also suffered from the general upheaval in the labour world. After referring to the strike of last year, the speaker, in reviewing the accounts, said that the redeeming feature of the year's operations was the continued and steady increase in the traffic receipts, notwithstanding an estimated loss of about £80,000 due to the labour troubles. This indicated a great revival of business activity in Buenos Aires. The number of passengers reached the record total of 370,734,965, an increase of 6.14 per cent., although the car mileage was greater by only 1 per cent. The system now consisted of 395½ miles of single track. Last year they carried 937,383 passengers per mile of route. The average fare paid was 2.01d. per passenger. The seating capacity of the cars is 32 and trailers are employed. The working expenses reached the high level of 78 per cent. of the gross receipts. The total expenditure for the year amounted to £2,573,742, being an increase of £198,178, or 8.35 per cent. Under the head of traction, £832,186, chiefly cost of electric energy, there was a small decrease of £24,934. It was, nevertheless, an encouraging sign. It showed that the tide of ruinous prices was on the turn, although it would not go back to the pre-war level. In the year 1918 when coal delivered at Buenos Aires was little short of £10 per ton, their electric energy cost £531,215 over the normal pre-war days, when the price of coal was 30s. per ton. They had still an immense amount of leeway to make up, and the present fuel situation was none too bright. In the years to come they must expect renewals to involve a much heavier expenditure than in pre-war days. He would be disappointed if the results of the current year did not enable them to augment considerably the transfer to this fund. The holders of the first preference shares had not received any dividend since June 30th, 1917, the arrears to December 31st last being £440,000 gross. The directors now recommended the payment of a dividend on these shares, less income tax, in satisfaction of the arrears for twelve months to June 30th, 1918, absorbing £123,200. A full year's interest at 5½ per cent. would, of course, be £176,000. The difference of £52,800 was deducted from the shareholders to pay income tax. Although the amount brought into revenue from 1918 would be reduced by this payment from £83,042 to £52,309 the directors were of opinion that the payment of arrears should be dealt with as promptly as prudence would allow. They had received the figures for the first five months of the current year, and they encouraged the hope that it might be possible to make increasing payments on account of arrears, and so ultimately to resume the regular payment of current dividends. The estimated figures showed that the current dividend on the first preference shares had been more than earned. Without making any promise, the results encouraged their expectation that they might be able to pay off another year's arrears of dividend on the first preference shares before very long. On the second preference shares no dividend had been paid since December 31st, 1915. There were thus four years of arrears, amounting to £550,000. It would be unwise to forecast any date when the payment of these arrears was likely to be commenced, but, if labour conditions remained tranquil, the further demands on the sorely tried patience of the shareholders might not be excessive. The ordinary shareholders had had no return on their invested capital for six years. The sufferers in that respect were the Société Générale at Brussels, who controlled the ordinary share capital, and whose patience certainly deserved to be rewarded, for during all that time they had never grumbled, but had always done everything they could to strengthen the company and support the hands of the directors in following a careful and conservative financial policy. When it was remembered that, in the year 1913, a dividend of 6¾ per

cent. was paid on £3,250,000 ordinary share capital, while the average of the two previous years was 8 per cent., they would realise how far they had fallen from pre-war prosperity, and how irresistible was the company's claim to a revision of tariffs. That revision has now been authorised, and should have a favourable effect on future revenues. He did not claim that they had got all they wanted, or all that was desirable, even in the public interest. The settlement was necessarily a matter of some adjustment. The essential provision was that a tariff of 12 cents was to be applicable everywhere—on the surface lines and in the subways—where previously they charged 10 cents. The increase of 2 cents paper was fixed for a term of three years. The 12-cent rate was inaugurated on April 10th. Some small awkwardness was experienced on the first day, arising out of difficulties of payment and change, but these soon disappeared. The new tariff was now working smoothly, and the effect on the receipts was already noticeable. They were trusting to the increase in fares to enable them to meet the heavy additional burdens which they now had to bear, but they looked chiefly to the growth of traffic for an improvement in the margin of profit. The chairman concluded his speech with a cordial welcome to Mr. Pedriali, the manager in Buenos Aires, who was now a director.

Aluminium Corporation, Ltd.

Mr. Samuel G. Bibby, the deputy chairman, presided at the annual meeting held on June 30th at the Great Eastern Hotel, E.C. Proposing the adoption of the report and the balance sheet for the three years ended December 31st last, he said that the issued capital since the date of the last accounts showed an increase of £67,210. The first debentures had been reduced by the first half-year's operation of the sinking fund, and an issue of £50,000 second debentures had been made to meet heavy capital expenditure. Mortgages had been increased by £22,028 due to the expensive purchases of land for the purpose of extending the company's water rights. The profit and loss account for the three years, before deducting debenture and loan interest, showed the figure of £129,955, or an average of just over £43,000 per annum. That had enabled them to pay the preference dividends for 1917 and 1918, leaving a balance of £60,623. After paying the preference dividend for last year, the board recommended that £30,000 of the balance be placed to a reserve account for special depreciation and possible Imperial taxation that might be imposed. £331,485 had been expended during the past three years on additional works. That item included the construction of the Llugwy dam giving a storage of seventy million cubic feet, which had been completed during the present month, and the work for the construction of the Cowlyd Dam, which they hoped to complete early next year. The latter had at present reached the stage when the concrete core wall was above ground level, being the most difficult and costly operation of the undertaking. That dam when completed would have a storage capacity of four hundred million cubic feet, and was being erected under the powers of the special Act of Parliament which was passed during the war period. They had also constructed at Dolgarrog a large extension to their rolling mill, which had proved a satisfactory addition to their plant. A new recasting shop had been erected and fitted, and the area of the works very considerably increased. A new 3-phase alternator and switchboard of 1,200 KW. capacity with direct coupled exciter had been purchased and installed, together with a 34,000-volt transformer, and further plant had been provided for the extended rolling mill. The investments and loans to subsidiary companies stood at £18,167, which was some £8,000 less than in the last accounts. The stocks stood at £77,191, which was not excessive for the amount of their turnover. Sundry debtors at £43,999 16s. 9d. were the usual trade items. The total figures of the balance sheet for the first time exceeded the sum of one million pounds, and showed in some measure the great expansion that had taken place in the business. The Corporation had guaranteed the principal and interest on £150,000 debenture stock in an associated company, and it was not necessary for him to dilate upon the services that Mr. Kenneth M. Clark, the chairman, had rendered the company during the very difficult period that they had gone through. He had on each and every occasion come to the aid of the company in the most generous manner, and he could confidently say that it would have been absolutely impossible for any such statement as the present to have been produced, had it not have been for the continuous and very extensive financial assistance he had given. During the period under review an opportunity occurred for the purchase by the company of the controlling interest in the North Wales Power & Traction Co. That company was really the parent company of the Aluminium Corporation, and it was that company which sold to the Aluminium Corporation a portion of its estate, which was the original watershed of the Corporation. The two companies were working to some extent in opposition, and bearing in mind the fact that the two stations were connected by a 20,000-volt transmission line, they would easily perceive the great advantages of the amalgamation. Mr. Clark very generously found the amount required in hard cash at a most difficult financial period, for the purpose of the purchase, and accepted for the money first debentures in the North Wales Power & Traction Co. Since the date of the purchase new machinery had been installed in both power stations, the transmission line had been strengthened, and they were now working in unison to the manifest advantage of both companies. That purchase, coupled with the purchases of land that had been made during the last three years, gave the company the only economical storage ground for water in Snowdonia, and it had consolidated and strengthened the position in a manner that would appear, he confidently believed, in the future history of the undertaking. The crux of the whole position with regard to the company rested upon the amount of electrical energy generated, and that, of course, entirely depended on the water storage. A great deal had been done in that direction, they had an output now three times what it was in the early years, but they still had a considerable water storage undeveloped, and they were as yet unable to provide a dividend for the ordinary shareholder. In conjunction with the North Wales Power & Traction Co., they now had large possibilities with regard to the sale of electric energy to towns, quarries, and other industries, in addition to their own consumption, and the board felt that there was every prospect of their being able to pay a dividend on the ordinary shares providing the necessary developments could be carried out, but that, of course, meant further heavy expenditure on capital account. New dams to conserve the rainfall must be constructed, further pipe lines were needed, and a new power house must be built. So far they had not been able to see their way to meet those requirements, a great deal had been done, but a great deal more remained to be carried out. The matter was receiving the careful consideration of the directors, for they were confident that the extensions would yield a very handsome profit, especially having regard to the fact that a great deal of the expenditure which had already been made would be contributory to those new works, but in what form the necessary and essential expenditure could be met he was unable at the moment to say. He would, however, call their attention to the fact that that was the only high pressure hydroelectric scheme in operation in England or Wales. The Government was taking a keen interest in the development of water power, and the position of the country with regard to coal made it a national duty that water power of that description should be developed to its fullest capacity. A great deal has been said as to the Government providing the necessary funds, but they really could not expect any Government to do all the development work required by the country, nor personally did he think that that would be a wise course. England has obtained her pre-eminence in the commercial world by the initiative of her people, and it was, in his opinion, very much to be desired that that policy should be continued, and that enterprises of that sort should be carried out by private capital, but of course labour was difficult and taxes were heavy. Unfortunately they were one of those companies upon which excess profits duty fell with exceptional severity, for they did not reach remunerative production before the standard period, the result was that they were handicapped by the figures established for that period. The continuation of that duty, was, to his mind, to be deplored, and he could not help expressing the opinion that if the Chancellor of the Exchequer realised how greatly that tax was hampering the development of undertakings of that class and character he would certainly not have increased it. The great need to his mind was stability; he certainly thought the continuation of the excess profits duty beyond the actual war period a great mistake, but they, of course, realised that the national expenditure must be met, and if the Government found that they were unable to raise the necessary revenue by any other means than that of continuing the duty, then he would suggest that it should for the present year be not more than 50 per cent., and that a definite undertaking should be given that it would either be abolished after this year or reduced by at least 10 per cent. each year until it was extinguished. That would, in his opinion, make the raising of capital a very much simpler problem, and it would ensure that when the tax disappeared the expansion of business in this country would have more than made good any deficit in the revenue accounts. Although the production of aluminium had been greatly increased during the war, particularly in America and Norway, he was glad to say that the demand had kept pace with the supply, and they had found no difficulty in disposing of their output. When the Government decided to dispose of their stocks of aluminium, they took over a considerable portion of the metal, which had been duly marketed. The chief difficulty of the outlook was the question of supplies of raw material; the freight market showed signs of easement, but the costs of production had been considerably increased by the continuous rise in wages, coupled with the reduction of working hours and cost of coal, and it was now a question whether wages had not reached their economical limit. There was a further possibility of the French Government placing an export duty on bauxite, their chief raw material, in which case they would be obliged to interest themselves in the considerable deposits of the ore known to exist in the British Empire, and the board had at present under consideration certain negotiations in that direction. In conjunction with their interest in the North Wales Power & Traction Co., they were arranging to use a portion of their electricity for public supplies, and had in hand at the present moment the construction of a high voltage transmission line, connecting their works at Dolgarrog with the towns of Colwyn Bay and Llandudno.

J. G. White and Co., Ltd.

Addressing the annual meeting, on June 29th, Mr. G. M. Booth said that having regard to commercial conditions in general, they were determined to pursue a policy of extreme care, and were doing everything possible to consolidate their position and resources. Consequently the year's trading had been quiet and the profits moderate, and the current year was likely to find them less aggressive and satisfied if they held their own without loss. It would be a mistake to embark on any large enterprise at this juncture about the completion of which, on financial grounds, they did not feel entirely independent of money market conditions. The period of readjustment after the war had begun. It would certainly last some years, and in the earlier stages some acute moments of distress were bound to occur, and in his opinion the year 1920 was bound to contain perhaps the most acute of these crises. The general trading business, which they now conducted under the name of J. G. White Commercial Co., had been working under particularly difficult conditions. They were progressing satisfactorily. As with the engineering business, they were pursuing a conservative course, and while every month showed handsome increases in turnover, they could grow much more rapidly if they were ready to do so, but strictly conservative finance necessitated the turning down of quite a number of orders. The result of the amalgamation of their own construction department with that of Messrs. Dick, Kerr & Co., Ltd., was entirely satisfactory.

British Electric Traction Co., Ltd.

Mr. E. Garcke, M.I.E.E., presiding at the annual meeting, on Friday last, said that during the past year Parliament had passed two Acts with a view to the amelioration of the adverse conditions in the electrical industry. The Electricity Bill contained no assertion of abstract principles of freedom, but it met unquestionable evils by practical remedies. The Act did not remove all their grievances, but it authorised the appointment of Commissioners whose functions, they understood, were to examine the conditions and to legislate for the varying circumstances of particular cases consistently with general policy. That was the form of regulated freedom for which they petitioned. The Government had given them that measure of freedom, but had made the reservation that it would enact the objectionable clauses which the House of Lords deleted. It was to be hoped that the Government would announce at an early date its abandonment of that policy, for it was undoubtedly true that further uncertainty had a serious deterrent effect on enterprise in that important key industry. The other Act—the Tramways (Temporary Increase of Charges) Act, 1920—was of importance to the electrical tramway industry. Tramways were overrun by increased costs, but were not allowed to keep up with increased prices and charges. The Ministry of Transport had, however, come to their rescue, and, he believed, was doing everything it could to enable those undertakings to hold their own. Referring to questions of general interest, he said that the existing financial and industrial conditions of the world gave rise to anxiety. The need at the moment was that the simplest truths of economics should be observed by all. War meant destruction of wealth, and they could not be as wealthy after the destruction as before until the loss was made good by new production. In the next place, the war had changed their outlook with regard to many social questions; the working classes rightly claimed an improvement in their status. That claim should be met not in a haggling spirit, but by fair and sympathetic discussion of the economic and social principles involved. If, as had been said, the country had reached its taxable limit because there was no satisfactory alternative to the admittedly bad tax on so-called excess profits, then the only remedy was ruthlessly to curtail national expenditure. This country was again in a favourable position for securing world-wide industrial prosperity, because foreign competition was not effective, and practically the whole world was clamouring for British goods; but it could not enlarge and extend its foreign trade if taxation beyond its capacity discouraged industry and encouraged extravagance. The excess profits duty had those effects, as every industrialist knew. Until the world's production overtook consumption, prices would not come down, and it would be a serious matter for producers in this country if the simple remedies of earning more and spending less were delayed, and they had to look for relief in the form of foreign competition. The dangers of high prices are great to every section of the community. The labour situation was now discussed by all, but sufficient consideration was not, he thought, given to some of its aspects. The wages system which regulated the relations between capital and labour during the past century on the principle of unregulated supply and demand, had broken down under the stress of the friction to which it had given rise. The Whitley Councils had brought the labour unions and the organisations of employers together. So far, good. Those Councils performed the function of cutting a thorny path through the jungle of premature ideals and over-ripe realities, but in the absence of guiding principles of national application, the path had no clear direction and no recognisable alignment. It was a continuation of the old struggle with changed procedure: labour demanded more, employers resisted and finally yielded; then the process was repeated. But no one knew the end. They needed further co-ordination of interests, and the most helpful suggestion at this point was that the Whitley Councils should be federated for debate and decision on the root questions underlying the labour situation viewed nationally and not only sectionally. In the present case capital did not fully admit the social rights of labour, and labour did not fully recognise its moral obligations to society. Proceeding to refer to the results of their federated public utility undertakings, excluding the London companies, he said the receipts were £2,647,000, an increase of £245,000; the expenses were £1,941,000, an increase of £339,000; the working balance was £706,000, or £94,000 less. The percentage of working expenses to gross receipts was therefore 74 per cent. in 1919, compared with 67 per cent. in 1918. They did a larger volume of work but made less profit, both absolutely and relatively—not a satisfactory result, but unavoidable though regrettable. The operations of the London undertakings had produced even worse results. They had a total investment of over £700,000 in the London group of tramway, omnibus, and electricity supply undertakings. During the past two years they had had a net revenue of only about £8,000 per annum on the portion of that capital represented by debentures and some preference stocks. In 1913—the year before the war—they received over £25,000 on about £75,000 smaller investment, and they then had good reason to hope that the yield would improve. The falling away of the profit on the London undertakings had told heavily against them. In the case of their provincial undertakings, comparing only like with like, and eliminating incomparable undertakings, the operating profits had, in the aggregate, increased since 1913. If the London companies had done approximately as well, the revenue account of the B.E.T. Co. would be at least £20,000 per annum better than it was. The tramway and omnibus companies of the metropolis had increased their traffic receipts between 1914 and 1919, but their expenses had increased in a much larger ratio, and at the beginning of this year they were not earning sufficient to meet their actual expenses. It was difficult to give a satisfactory explanation why the London results were so much worse than those of provincial undertakings—the reasons were many and complex. All the transport services in the London area—the tubes, omnibuses, company-owned tramways, and municipal tramways—were reciprocally competitive, producing difficulties which even administrative co-ordination could not entirely remove. There was always a tendency for the lowest fares and the highest wages on any of the services to become the standard for all the undertakings. There was no doubt that basic wages were higher in London than on their provincial undertakings, and the cost of fuel and of all other materials was probably higher also. Moreover, distances were greater and longer travel had to be allowed for the minimum fare. Workpeople were carried at a loss. Lord Ashfield, the chairman of the London and Suburban Traction Co., at the annual meeting in May last, expressed the belief that the public would pay such fares as would produce a revenue necessary to keep the undertakings in a reasonably prosperous condition, but he warned those who were constantly agitating for increased wages that they could overburden the undertakings and bring disaster to themselves and to all those associated with them. Since then the Ministry of Transport had under the new Act authorised the Metropolitan and the London United Tramway Co.'s to charge increased fares; but the employés had at the same time obtained a further increase of wages, although it was not yet known what was likely to be the continued result of the increased fares. Speaking of the various departments of the business, Mr. Garcke said that with regard to the tramways and light railways, the receipts continued to increase; but the expenses increased in a greater ratio, and the average increase in fares had been equal to only one-tenth of a penny per passenger. Their automobile business was showing satisfactory expansion in various parts of the country. The increase in the cost of petrol since pre-war days by over 200 per cent. had, however, still further reduced the narrow margin of profit; but in the case of omnibuses they were not under the same restrictions as in the case of tramways with regard to the fares they could charge, though they had in many cases already reached the economic limit beyond which fares could not be raised without discouraging travel. In the case of the electricity supply business, there was a precipitous falling off in demand immediately after the armistice, but the expenses could not immediately be arrested. During the year, however, the output of electricity sold gradually increased, and the level of 1918 had been almost restored, a recovery which showed the satisfactory elasticity of the business. The main item of expense was fuel, and the average price of coal had been much higher in 1919 than in 1918. In the manufacturing department of the business, which was represented by the Brush Electrical Engineering Co., they had very good results to show. Owing to the industrial lag caused by the war, all manufacturers of electrical apparatus were full of orders, and the demand upon British manufacturers had been accentuated by the fact that foreign competition had been practically eliminated. The Brush Co., in which they had a substantial interest, had made an excellent showing for 1919. A dividend of 15 per cent. had been paid, and there had been a bonus capital distribution of 100 per cent. There was a large demand for the special manufactures of the Brush Co., and they confidently anticipated a continuance of the present prosperity of that

company. The chairman dealt in conclusion with the accounts. He added that the board had acquired an interest in a company formed in association with Sir Oswald Stoll to produce kinematograph pictures. Mr. Garcke said that was his twenty-fifth year of service with the company, and after nearly fifty years of strenuous industrial activity he felt a desire for leisure to work at other things. He had, therefore, resigned the chairmanship of the company, and Mr. J. S. Austen had agreed to succeed him in that capacity. He would be willing to remain a member of the board, and if it was desired by the federated companies, he would continue to act as president of the British Electrical Federation so as to avoid any sudden changes in that organisation. Replying to a shareholder, the chairman said the matter of paying an interim dividend on the ordinary shares had been before the board on several occasions. The bulk of their revenue was obtained from investments in companies which made out their accounts at the end of the year; but the risk of paying an interim dividend was not a very serious one, and he had no doubt the board would give the matter further consideration.

Edmundsons' Electricity Corporation, Ltd.

For the year ended March 31st, 1920, the directors report that after providing for income tax, mortgage and note interest, and debenture stock charges, the net profit was £8,099, as compared with £13,638 for the previous year. With £6,765 brought forward, the total profit available is £14,865; £4,775 is to be applied in writing off the discount and issue expenses of the £75,000 6½ per cent. three year notes, and £10,090 carried forward. Owing to the necessity under present conditions of conserving the company's financial resources, the directors are unable to recommend the payment of the cumulative preference share dividend. To provide for the immediate financial requirements of the company, the directors have been reluctantly compelled to resort to the issue of £75,000 6½ per cent. three year notes secured on £100,000 5 per cent. prior lien debenture stock. The various undertakings have suffered severely from their inability to adjust prices sufficiently to meet the constantly increasing costs of supply. In the hope of overcoming this difficulty, the directors promoted a Bill in Parliament which was rejected by committee. It has, however, served to bring home to the authorities the urgent need for relief, and the Electricity Commissioners and the Ministry of Transport are now considering by what means relief can be most readily afforded. In the meantime a large number of applications for substantially higher prices have been lodged with the Ministry of Transport. Investments in and advances to subsidiary and other companies at March, 1920: Shares, £683,210: debentures, £175,930; advances, £567,928; total, £1,427,068.

Name.	Capital expended Dec. 31st, 1919.	Gross profit (before providing for capital charges and depreciation). 1919.	Load connected in kw. 1919.
Alderley	£55,977	£2,954	1,319 kw.
Bromley	161,365	11,186	5,100
Folkestone	244,038	16,848	6,000
Guernsey	109,490	6,000	5,447
Isle of Wight	278,295	12,498	6,444
Ilfracombe	85,658	1,166	1,019
Lancashire Co. ..	868,585	53,430	29,136
Lymington	37,149	1,881	911
Melton Mowbray ..	43,514	3,110	1,044
Newmarket	45,038	2,959	1,177
North of Scotland ..	123,188	6,190	4,559
Ramsgate	59,459	4,247	1,679
Scarboro' Trams ..	99,430	2,849	—
Salisbury	74,359	5,815	1,986
Urban Co.	1,577,622	63,221	43,297
Wycombe	122,497	2,845	3,182
Cromer	34,608	100	682
Dorking	46,970	2,781	1,314
Frome	64,741	21	2,922
Hamilton	85,827	5,317	3,251
Burbiton	72,065	4,642	2,329
Total 1919	£4,227,129	£208,692	129,988 kw
„ 1918	£3,972,587	£194,282	112,191 kw.

Meeting: July 15th.

Globe Telegraph and Trust Co., Ltd.

At the recent annual meeting, Sir John Denison-Pender said that the three great telegraph companies, the Eastern, the Eastern Extension, and the Western, had increased the dividends on their ordinary stocks and shares from 8 per cent. to 10 per cent. per annum, and as the Globe Co.'s holdings in those companies were very large they were able, in consequence, to increase the dividend on their ordinary shares in the same way. During the year the three companies issued new capital, and the proportion of new shares thus offered to the Globe Co. represented nearly £700,000. They took up the whole of the allotments to which they were entitled. They had sold the whole of their holding in the Central & South America Telegraph Co. at a net profit of more than £115,000. As the three companies in which they were interested had now announced their intention of paying their dividends, in future, by equal quarterly instalments, this policy might enable the board to equalise more nearly than had hitherto been possible the quarterly dividends on the ordinary shares of the company. However, the financial year upon which they had just entered must clearly be treated as an excentional or transitional one for dividend purposes. When the present transitional period was past and the cable companies were paying their full year's dividends on the new shares, the dividends the Globe Co. would receive on the new shares allotted to them would amount to a little over £70,000, while the dividends the Globe Co. were paying on the new shares would only cost them a little over £60,000 per annum, so that, so far as they could humanly foresee, the prospects of the company were exceedingly good.

Crompton & Co., Ltd.—The net profit for the year ended March, 1920, after providing for depreciation, interest on debentures, directors' fees, &c., and a reserve estimated to be sufficient to cover excess profits duty for the year, is £52,878, plus £17,409 brought forward. There is put to general reserve fund £15,000, to depreciation of investments £9,000, dividend of 10 per cent. for the year on the preference shares, £13,688. Dividend of 10 per cent. per annum on the ordinary shares £14,422, leaving to be carried forward £18,177. In view of the continued expansion of the company's business and the increase in price of all material, it is considered advisable that the limitation imposed by article 80 on the borrowing powers of the directors should be removed, and a resolution to this effect was to be submitted to the meeting yesterday.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under Temporary Regulation 4 (3):—

Ever Ready Co. (Great Britain), Ltd.—102,007 7 per cent. cumulative participating preference shares of £1 each, fully paid, Nos. 1 to 102,007; and 28,000 7 per cent. cumulative participating preference shares of £1 each, 5s. paid, Nos. 102,008 to 130,007; and 230,000 ordinary shares of £1 each, fully paid, Nos. 200,001 to 430,000.

Prospectus.—*Durelco, Limited.*—This company, whose registration was published in the Electrical Review for June 18th, is now before the public inviting subscriptions to an issue of 112,000 shares of £1 each at par. The company has been formed to acquire and operate the business of Duram, Ltd., Metal Manufacturers, Ltd., and Cryselco, Ltd., under one control, to provide additional working capital, and extend the plant and manufacturing facilities. The list is to close on July 14th.

Electro Bleach & By-Products, Ltd.—At the annual meeting, at Manchester, on July 1st, Sir H. Mackinder, M.P., said that the exchange of shares with Brunner, Mond & Co. had now been carried through. He was quite convinced that the success of the company was not due to the peculiar circumstances of the war, and he was confident that the company would have been just as prosperous, or even more so, had there been no war.

Lima Light, Power & Tramways Co.—Dividend of 2 per cent., payable as to 1 per cent. in cash and 1 per cent. in ordinary shares of the company.

Callender's Cable & Construction Co., Ltd.—Letters of allotment in the new issue of preference and ordinary shares were posted last Friday.

Rees Roturbo Manufacturing Co., Ltd.—Dividend of 15 per cent. on preference for the years 1912, 1913, and 1914; £3,500 for maintenance of buildings, plant, &c.; £1,683 to bad debts reserve; £2,853 forward.—*Financial Times.*

Major & Co., Ltd.—Final dividend of 2 per cent. on the preferred ordinary shares, making 9 per cent. for the year; 10 per cent. on the deferred ordinary, and a bonus of 1s. per share, free of tax. Carried forward £11,445.

Birmingham District Power & Traction Co.—To renewals £10,000; to reserve £1,050; dividend of 6 per cent. on the ordinary shares; carried forward £4,354.

Evered & Co., Ltd.—Net profit for 1919 £6,259, plus £8,055 brought forward, making £14,314, which is to be carried forward.

Anglo-American Telegraph Co., Ltd.—Interim dividend for the quarter ended June 30th 15s. per cent. on the ordinary stock and 30s. per cent on the preferred stock, less tax.

STOCKS AND SHARES.

Tuesday Evening.

The first week of the second half of the year brought to Stock Exchange markets a measure of relief from the anxieties and the apprehensions which had disturbed them during June. Money is being released to some extent by capitalists, large and small, who had kept the cash in their banks against June 30th, but who are now investing it in the various departments of the Stock Exchange. Industrials, however, are weighed down, and will continue to be affected by the 60 per cent. E.P.D. The Stock Exchange rumour that Mr. Austen Chamberlain is about to resign in favour of Sir L. Worthington

Evans has been denied by the Chancellor himself, but in spite of this, there are some optimists who cling to the hope that relief will be afforded even in the current financial year from the shackles which the extra tax imposes upon business and enterprise.

The passage of the third reading of the London Electric Railways Company (Fares, &c.) Bill had a slightly depressing effect upon prices in the Underground market, though they would probably have gone back in any case in sympathy with the heaviness amongst the steam stocks on disappointment with the recent White Paper dealing with Home Railways as a whole. The Government's scheme holds out no attraction to the public to put money into the industry, and its various good points are obscured by the suggestion of nationalisation involved in the willingness of the Government to take a share in whatever extra profits may be made, though not to shoulder any loss. People are disappointed, and it has induced a general setback in prices. Underground Income Bonds are 2 down at 57½, and the £1 shares fell ½ to 32s. 6d. Metropolitans are easier. The defence of his action by Mr. Walter Runciman, in connection with the bargain made by his department with the District Railway, aroused languid interest. Districts rallied to 15 on the Bill being passed; earlier the price fell to 14.

Electric lighting shares are without any movement on the week. The market has approached a state of stagnation, if, indeed, it has not already reached this condition. To buy and to sell are equally difficult, for dealers are not anxious to part with shares for which they have given more money, while, on the other hand, they are reluctant to take on their books further supplies of stock unless they know where these can be placed. The position therefore is that wide prices are quoted, and business has become a matter of negotiation, in the course of which buyers and sellers are as a rule dissatisfied. The Bournemouth and Poole Co. is offering 7½ per cent. seven-year notes at 100.

The General Electric report is considered decidedly good. The net profits for the year show an increase at £630,000, which amount is raised to £770,000 by the balance brought in from last year. The ordinary shares again get 10 per cent., free of tax. The report states that the company's works are fully employed, and to judge by orders in hand, they are likely to remain so throughout the coming year. A few of the company's subsidiary supply companies continue to suffer through conditions caused by the war. Next Tuesday's meeting will certainly produce an interesting speech from the chairman. Meanwhile the price of the ordinary shares remains at 32s. 6d. and the new ordinary are 29s. Share for share, the latter are a trifle cheaper to buy than the old, and during the past few days some of the shareholders have been selling their preference shares and putting the money into the new ordinary. From the point of view of the investor who looks to security and fixed interest, the company's 7½ per cent. "B" preference at 20s., or a little under, appear attractive enough. The 6½ per cent. "A" preference, as shown in our list, stand at 18s. 6d. middle.

Electric Constructions at 20s. have lost 1s., and the yield on the money on the basis of the last dividend is therefore 10 per cent. Callender's at 1 5-16 have gone back 1-16. The allotments of the new shares are out, and dealings are taking place in the new ordinary on the basis of 4s. premium. These shares, it may be recalled, were offered at 22s. The new 7½ per cent. "B" preference, with 15s. paid, stand at 13s. It is stated in the market that the underwriters were left with about 30 per cent. of the issue, which they had to take in the way of what the Stock Exchange calls a mixture of ordinary and preference together.

Aluminiums are a steady market on the meeting the other day. The chairman pointed out that while the Government is taking a keen interest in the developments of water power, he did not think it would be a wise course for any kind of nationalisation to be applied to the industry. From the purely business point of view, there are not many who would dissent from his sentiments. Under private control, industry is carried on much more cheaply, and generally with greater efficiency, than it is when the State assumes the reins. The Aluminium Corporation, according to the chairman, has now an output three times what it was in the early years of the company, but he went on to say there was a considerable water storage under development. British Insulated are a few pence lower, but otherwise the list of manufacturing prices remains without alteration.

Mexico has taken a step backwards in the direction of restoring settlement in the country, with the result that most of the stocks and shares connected with Mexico have given way to some extent. The only exception is the preferred stock of the Mexican Light & Power Co., which is 1½ higher at 27½, although the first mortgage bonds are lower at 49. Pachuca fives are 4 higher at 47½, but the various other issues connected with utility companies are mostly easier. Some fresh handful of brigands is apparently causing trouble, and sporadic outbreaks of this nature are bound to occur during the process of Mexican reconstruction. Anglo-Argentine Tramways second preferred moved up to 3½, business being done at this price; the 5 per cent. debenture stock at 58½ is a little lower, in spite of the attractions which the security now offers to those who look for a higher yield on their money, and who recognise that the Anglo-Argentine Tramways Co. is steadily working its way back to prosperity.

The Treasury have notified that they will return on October 1st to the original holders the bonds and stocks of many American railroad and utility companies which were lodged with the Government under the mobilisation scheme set up during the war for the purpose of regulating exchange between here and the United States.

Indo-European Telegraphs have gone back to 30, a fall of 50s., and Great Northerns are also £2 down at 21½. Last week's gains are, therefore, lost in both cases. The cable market is uninteresting, and not even Marconis present any particular degree of animation. The various new issues of the Eastern group hold their prices firmly. Eastern Extension new £2 paid are 5, and the fully paid 13; Eastern new shares, 4s. paid, 11s., and the fully paid 27s., while the new Westerns are 5½ and 13½ for the partly paid and fully paid respectively. The rubber market is quiet, maintaining, however, a fair amount of steadiness in view of the possibility that there may be some shortage in the raw material develop during the next two or three years. Some claim that the low price at which rubber now stands, namely, about 1s. 11d. a lb., is artificial, and that the consumers are deliberately holding back their immediate purchases, with a view to getting their rubber more cheaply later on. As to which, who lives will see. The armament markets, Vickers and Armstrongs particularly, remains under a cloud. Vickers gave way as a result of the Sir Percy Scott law-suit against the company. Evidence accumulates of the difficulties experienced by industry in many directions, not only by reason of the high cost of money, but owing to the difficulty of obtaining financial accommodation where this is necessary for extension of business. But the Stock Exchange does not appear to hope for a reduction in the Bank Rate in the near future.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price July 6, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	63	—	£9 8 2
Charing Cross Ordinary	4	7	84	—	10 0 0
do. do. do 4½ Pref.	4½	4½	2½	—	8 8 8
Chelsea	3	4	2½	—	8 0 0
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 2
County of London	7	8	8½	—	9 17 0
do do. 6 per cent. Pref.	6	6	8½	—	7 5 5
Kensington Ordinary	6	7	4	—	8 15 0
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	2½	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	2½	—	8 6 0
St. James' and Pall Mall	10	13	6½	—	8 16 10
South London	5	6	3½	—	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5½	—	9 15 2
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	78½	—	7 13 10
do. Def.	33/6	1½	17½	—	8 9 0
Chile Telephone	6	6	6½	—	*4 12 2
Cuba Sub. Ord.	7	7	8½	—	*8 4 8
Eastern Extension	8	10	14½	—	*6 18 0
Eastern Tel. Ord.	8	10	145/-	—	*6 17 6
Globe Tel. and T. Ord.	8	10	15½	—	*6 7 8
do. do. Pref.	6	6	8½	— ¼	7 1 2
Great Northern Tel.	22	22	21½	—2	10 4 8
Indo-European	13	10	30	—2½	8 6 8
Marconi	25	25	3½	— 1/16	7 12 10
Oriental Telephone Ord.	10	12	2 7/16	—	*5 4 4
United R. Plate Tel.	8	8	7½	—	*6 12 8
West India and Panama	1/8	Nil	1/16	—	Nil
Western Telegraph	8	10	15	—	*6 13 4
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	20½	—1	8 2 0
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	— ½	Nil
do. do. "A"	Nil	Nil	4/6	—	Nil
do. do. Income	5	4	57½	—2	8 19 2
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	3½	—	8 8 6
do. do. 2nd Pref.	Nil	Nil	3½	+ ¼	—
do. do. 5 Deb.	5	5	58½	—1½	8 11 0
Brazil Tractions	Nil	—	47	—	—
Bombay Electric Pref.	6	6	13	—	4 10 0
British Columbia Elec. Rly. Pfcn.	5	5	58½	+1	8 11 0
do. do. Preferrred	2½	5	53½	—	9 7 0
do. do. Deferred	Nil	8	58½	—	5 12 8
do. do. Deb.	4½	4½	64	+1½	7 17 5
Mexico Trams 5 per cent. Bonds	Nil	Nil	39	—1	Nil
do. 6 per cent. Bonds	Nil	Nil	30	—	Nil
Mexican Light Common	Nil	Nil	14	—	Nil
do. Pref.	Nil	Nil	27½	+1½	Nil
do. 1st Bonds	Nil	Nil	49	—1½	1 17 10
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	93	—	*5 14 4
British Aluminium Ord.	10	10	1 5/16	—	9 8 2
British Insulated Ord.	12½	15	1 11/16	— 1/16	8 5 6
Callenders	25	15	1 5/16	— 1/16	11 8 6
6½ Pref.	6½	6½	1	—	7 8 7
Castner-Kellner	20	17	3	— ¼	5 13 4
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1½	—	7 12 4
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21	—	10 0 0
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 5
do. Ord.	10	—	32/6	—	*6 3 0
Henley	25	15	1½	—	8 0 0
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	10	13	—	*7 13 10
Met.-Vickers Pref.	—	6	2½	—	7 2 8
Siemens Ord.	10	10	26/-	—	*7 13 10
Telegraph Con.	20	20	21½	—	*6 11 8

*. Dividends paid free of Income Tax.

THE ENGLISH ELECTRIC CO.'S PHŒNIX WORKS, BRADFORD.

These works, which were visited by the members of the I.M.E.A. during the recent Convention, were established 20 years ago by the Phœnix Dynamo Manufacturing Co., Ltd., for the manufacture of electric motors and dynamos of a limited range of sizes and types. On the manufacturing side, attention has been concentrated on the continuous improvement of design and organisation of construction in series and quantities.

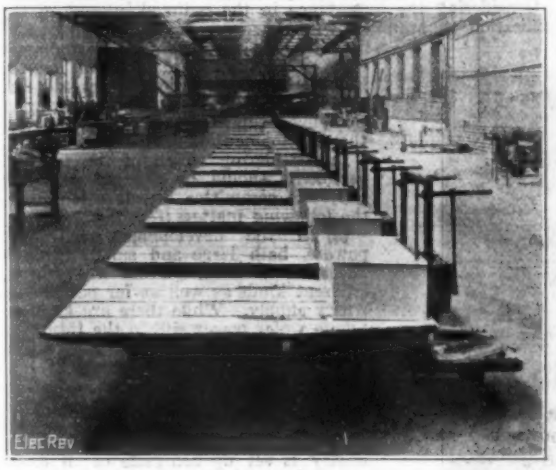


Fig. 1.—Phœnix Electric Trucks.

Fig. 2.—Winding Stores.

In the first instance, it was natural that the business of the company should develop in relation to local industrial requirements, and particular study was given to the special conditions pertaining to the Yorkshire coal-mining and the woollen industry. The Phœnix Co. was successful in developing a rapidly growing business with these two great local industries, in both of which there has been such remarkable expansion during the past 20 years. But the high technical reputation achieved by the company and the efficiency of its methods of manufacture enabled it gradually to extend its operations, and considerable business was done in other parts of the country and abroad, while larger sizes of machinery were, in more recent years, frequently manufactured for public authority contracts and industrial installations.

When it was decided to consolidate under the title of "The English Electric Co., Ltd.," the several works now owned by that company, the acquisition of the Phœnix Co.'s business was a very valuable part of the whole scheme. The purpose of the consolidation was, on the one hand, to obtain the benefit of a more comprehensive sales organisation throughout the world, and on the other hand, to take full advantage of the policy of specialist production in the several factories. The Phœnix Works have thus been applied to the most efficient methods of manufacture of certain sizes and types, and the production of larger electrical machinery has been allotted to other works of the English Electric Co.

Fig. 3.—Small Machine Erection Department.

Fig. 4.—Small Machining Department.

The policy pursued at the Phœnix Works is the standardised production of quantities of electrical machines of certain sizes and types by such methods as to combine the lowest cost with thorough soundness and efficiency. The term "mass production" is not properly applicable to this work, as, while every advantage is taken of possible means

of conveniently handling quantities of standard parts, the machine finally produced is in every respect a sound engineering job, undergoing the usual tests and complying with the most rigid specification requirements.

The Phœnix Works cover a large area, with ample room for future expansion, and at present employ 1,200 people. The great value of the local connection is continuously experienced, but through the organisation of the English Electric Co., the products of the Phœnix Works are steadily increasing in general reputation and demand.

The lay-out of the factory is marked by the interposition of the "central stores and inspection department," a bay 600 ft. in length, between the manufacturing departments and the assembly shops; in this large bay, of which we give an illustration, all materials are received, and from it they

Fig. 5.—Larger Machine Erection Department.

are issued to the workshops. After completion, the parts are returned to the department for inspection, and are then transferred to the assembly shops, of which views are given herewith. Other illustrations show the small machining department and the winding stores, and we illustrate also a batch of electric trucks built at the Thornbury Works.

The foundry is situated at the Dick Lane Works, and is equipped with automatic sand-handling devices and mould-

Fig. 6.—Central Stores and Inspection Department.

ing machines, which enable it to supply all the requirements of the works for light castings on repetition lines; sidings running into these works from the Great Northern main line provide for the reception and dispatch of goods.

Provision has been made in the adjoining "Phœnix Park" for the recreation of the employés; the site, which covers 70 acres, includes cricket and football grounds, bowling greens, and a nine-hole golf links, together with buildings for social purposes, all of which are managed by an association of the men themselves. Of the comforts of the canteen the I.M.E.A. visitors will bear away pleasant memories.

BRITISH WATER-POWER RESOURCES.

The second interim report of the Water Power Resources Committee, of which Sir John Snell is chairman, was recently issued (Cmd. 776. Price 4d. net). The original terms of reference, to report upon the water power resources of the United Kingdom, and the extent to which they could be made available for industrial purposes, were extended in October, 1919, to include a consideration of the steps that should be taken to ensure that the water resources of the country be properly conserved and fully and systematically utilised for all purposes. The report deals to some extent with matters of general interest that do not, however, directly concern us. On the other hand, what the committee has to say on the subject of water power development is of considerable interest.

Considering the importance in the national interest of the utilisation of water power wherever this is commercially practicable, the committee recommends that either the Board of Trade or the Electricity Commissioners should be specifically charged with the duty of studying, supervising, and promoting the development of water power.

In considering which of the two departments should be charged with this duty the committee directs attention to the following matters:—

(*a*) In the development of water powers, both large and small, facilities must be given for private enterprise of different kinds as well as for public electricity supply. While there are localities where water power will in the future be properly developed to assist the generation of electricity for public supply purposes, there will also be cases, especially in Scotland, where the geographical situation of the water power will only permit of its full utilisation if an industry is set up alongside or in direct connection with the water power station, *e.g.*, the British Aluminium Co. at Kinlochleven. In many cases the power to be developed may be small or remote from a public electricity supply system; in such cases private enterprise may be the only means of securing its development. It is necessary, therefore, that the department to which control and supervision are given should be absolutely impartial alike to public and private developments. It may, therefore, be that the Electricity Commissioners, whose primary duty is to promote, regulate, and supervise the generation and distribution of electricity would not be considered to fulfil this requirement.

(*b*) Both the Board of Trade and the Electricity Commissioners are "Great Britain and Ireland" departments, and their jurisdiction extends throughout the British Isles.

(*c*) The development of large water power undertakings necessarily takes some years, and during the constructional period capital is expended without any accruing revenue whatsoever. When once completed, however, the undertaking would be a valuable source of wealth, and it is important to remember that by far the largest proportion of the total running costs is represented by interest and other charges upon the capital sunk in the undertaking. Private enterprise will need encouragement especially in the Scottish Highlands, where the population is now too sparse to allow an undertaking of this nature to be established with funds advanced by local authorities to whom the large capital involved would be too great a burden to be practicable. It will, therefore, be necessary to assist some of the schemes out of national funds, the return on which should represent a sound investment for the State, and without which this valuable source of power would continue to be wasted.

(*d*) The Electricity (Supply) Act, 1919, includes certain provisions in connection with the development of water power. Under this Act, the Electricity Commissioners may conduct experiments for the improvement of the utilisation of water power, and they can authorise a joint electricity authority to enter into arrangements for the utilisation of water power for its own purposes. Under Section 1 of the Electric Lighting Act, 1909, as modified by the Electricity (Supply) Act, 1919, the Minister of Transport may authorise an electricity supply undertaker to acquire compulsorily or use land for the purposes of a generating station, and the later Act contains a provision which specifically includes the development of water power for the generation of electricity among the purposes for which a joint electricity authority may be authorised to take or use land under that section.

(*e*) Either department will have to add to its staff if these further powers are entrusted to it. If the duties are entrusted to the Electricity Commissioners, the committee thinks that the portion of their expenses which is attributable to this work should not be chargeable to electricity undertakings as is the case with the expenses of the Electricity Commissioners generally, but should be borne out of public funds or met by royalties on the power developed or by

charges for licences which should be issued as indicated below.

Some witnesses expressed the view that there is comparatively little water power in England and Wales remaining to be developed. The evidence of others, and the preliminary surveys undertaken on behalf of the committee, do not justify this view.

For example, ascertained facts regarding the water power resources of the Hampshire Avon, the Chester Dee, North Wales and Mid-Wales, Dartmoor and Exmoor, and the rivers in the West Riding of Yorkshire, represent a total catchment area of about 12,000 square miles. These figures, summarised briefly, indicate that in each of the instances quoted, *i.e.*, for various districts which have different physical characteristics and climatic conditions, the possible water power resources average approximately 10 continuous H.P. per square mile of catchment area. While it would be unsafe to assume that this average is applicable generally throughout England and Wales, the total area of which is approximately 58,000 square miles, and while it is also obvious that it may not be commercially feasible to develop the whole of the power resources at present unused, nevertheless the figures justify the conclusion that the water power resources of England and Wales, at any rate in parts of the country, are by no means negligible.

There are several parts of Great Britain in which there are large sources of water power, but very few inhabitants. It is unlikely that such sources will be developed unless some State assistance is available, and the department which is charged with the duty of developing water power should be provided with a fund for the purpose of starting enterprises in such areas with the approval of the Treasury. There will be many cases in which water power undertakings will in the long run be remunerative if they are assisted at the outset.

It is not recommended that the State should make grants to water power undertakings, but only that the State should give financial assistance in the earlier stages of an undertaking which takes several years to construct, and in which a period of four or five years must necessarily elapse before the undertaking is completed.

Whichever department may be charged with the control and development of water power, the committee thinks it essential that such department shall deal with water power not only for the purposes of the public supply of electricity, but also for its direct application to works constructed at the site of the water power station or directly dependent on it for the power required, whether these works are for public or for private enterprise, so that this great national asset may be utilised to the fullest possible extent. Provision should be made for securing that there is no interference with the development by private enterprise of water power unless such development is incompatible with the fullest utilisation of the source of power concerned.

In order that water power may be developed in the interest of the community as a whole, all schemes for the development of water power should be submitted to the department concerned, even if under the existing law no special powers are required. The department should have power to grant licences on suitable terms to public or private undertakers. If the terms of the department were not acceptable to the promoters, then the latter could proceed by private Bill, the department having power to give evidence in opposition.

Additional details of what the committee proposes are promised for the final report, to be issued shortly. Meanwhile the committee thinks it essential that some initial legislation should be promoted by the Government to broadly cover the points set out above, and to enable certain schemes to be initiated without further loss of time.

ELECTRIC RAILWAY CONTACT SYSTEMS.

By SIR PHILIP DAWSON, M.I.E.E.

(Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS.)

THERE are two distinct types of contact systems used on electric railways from which the current to feed the trains is collected. The older, and the one most generally in use in this country, being the conductor or live rail, which is only in use with direct current, at pressures varying from 500 to 1,300 volts, though it is proposed to increase the pressure with this system up to 1,500 volts.

Where pressures of 3,000 volts, D.C., or 6,000 to 16,000 volts, A.C., or 3,000 to 5,000 volts 3-phase are concerned, the questions of safety and of insulation have made it imperative to use overhead conductors. There is one case in this country where an overhead conductor is used with a pressure of 1,500 volts, D.C. The overhead conductor has been used in this case to clear the tracks and yards of live conductor rails.

It is not proposed to discuss the actual question of traction systems in this paper; suffice to say that so far only three countries have decided to standardise any one system for general railway electrification. These countries are Sweden, Switzerland, and Germany, which have definitely adopted the single-phase 16,000-volt 16⅔-period system with an overhead conductor. France is investigating the matter, and it appears probable that she will adopt the 3,000-volt D.C. overhead system, thus standardising the voltage as well as the system.

Italy has so far not arrived at any definite conclusion, although the majority of her railways so far electrified are on the 3-phase, 16-period, 3,000-volt system. The United States has no definite standard although the Pennsylvania Railroad appears to have decided on the single-phase system for all future electrifications.

In this country the whole question is under examination as to how far any one system shall be adopted as a standard for general railway operation.

Dealing with overhead construction for railways in a country where traffics are very intense, and the hours of service long, the overhead construction must present factors of security and safety at least equal to those obtaining on the permanent way, and it must be constructed in such a way as to enable any maintenance and supervision to be carried out in the very limited periods of time available for such purposes.

An overhead conductor can only be utilised where the currents to be collected from it are relatively small, as experience has shown that heavy currents are not only difficult to collect, but also very greatly increase the cost of maintenance.

OVERHEAD CONDUCTORS.

The overhead construction and the collector arrangements on the coaches or locomotives must be such as to make the risk of a collector coming off the contact wire no greater than the risk existing to-day of the wheels of a bogie leaving the track.

In 1907 when the first overhead lines for main-line purposes were being laid out in Germany, in the United States, and by the Brighton Railway, various principles of construction were adopted in order to fulfil the requirements mentioned above, and it is extremely satisfactory to be able to state that whilst considerable alterations have had to be carried out both in the United States and in Germany, the principles adopted in connection with the overhead construction on the Brighton Railway were such that the overhead construction in operation to-day is practically identical with that originally designed.

On the Brighton Railway the principles adopted in 1907 were:—

That the conductor wire should be as flexible as possible, and that all hard spots should be avoided.

That double insulation was essential and that the mechanical as well as the electrical factor of safety of the insulators and overhead construction must be very considerable.

That all insulators should be placed in positions where they would be least subjected to the direct effects of the hot gases given off from the steam locomotives.

That, with the exception of complicated yards and cross-overs, the up and down lines should be sectionalised so as to be able to be cut out independently, whilst the complicated cross-over roads and yards were designed in such a way as to be sufficiently short to be coasted over.

That insulators should be only utilised under compression, and that elastic substances should always be placed between the insulator and its solid support, as well as between it and the mechanical construction which it supported.

Provision was also made when designing the insulators that there might be no possibility of moisture or water collecting and freezing, thereby fracturing the insulator.

Fig. 1 shows the various clearances existing to-day between the live portions of the bow gear, the loading gauge, and the old and new minimum structure gauges on the Brighton Railway. The contour of the bow practically follows the contour of the loading gauge, also under present conditions the ordinary running width of the bow is 18 in., or 9 in. on either side of the centre line. This is the stagger at present adopted for the overhead construction on the Brighton Railway, although for the future, in consequence of the experience gained, this stagger will be increased to a maximum of 1 ft. on either side of the centre line. The width of the actual collector strip is 9 in. greater on either side of the centre line (in addition to the 9 in. allowed for stagger), or 18 in. in all on either side of the centre line, in order to allow for the rolling of the coach and for special conditions existing on very sharp curves, and this has been found ample in practice.

The lowest live conductor on the L.B. & S.C. Railway is 13 ft. 9 in. above rail level, *i.e.*, 3 in. above our loading gauge.

This 3-in. clearance has worked quite satisfactorily, though a minimum of 4 in. is worked to when possible. It is considered that 4 in. will be quite satisfactory for 11,000 volts.

Four inches is considered to be the minimum vertical point-to-point electrical air clearance which should be allowed for

voltages from 6,000 to 11,000, therefore, a minimum of 4 in. vertically and 3 in. horizontally is provided from any part of the live bow to a structure at any height after the proper allowance for rolling stock has been made. The rolling allowance in the case of the Brighton Railway is 5 in. on either side when the centre of the bow is at 16 ft. above rail level, which is the normal height of the trolley wire.

In this case it is also considered that the minimum point-to-point electrical air clearance from any live part of the overhead line equipment to the structure should not be less than 4 in. vertically and 3 in. horizontally for voltages from 6,000 to 11,000.

Working on the principles given above we can get a flexible overhead line construction within a minimum of 10 in. from the loading gauge to the structure, *i.e.*, within 14 ft. 4 in. above rail level, which 10-in. space is utilised as follows: 4 in.—air clearance between loading gauge and underside of trolley wire; 2 in.—depth of flexible line construction; 4 in. —air clearance between top point of live construction and structure.

In practice it has been found that there are a few isolated cases where the clearances required for a live conductor are not available and where the cost of alterations necessary to procure these would be excessive, and would not be justified by the results gained. On the whole of the running lines so far electrified, equivalent to 70 miles of single track, there are only four instances where sufficient clearances for a live conductor do not exist. Three of these occur at the bridges at the entrance to or in Victoria Station, where, owing to the lack of clearance, it has been found necessary to install earthed conductors. The difficulty in this case is accentuated by the fact that owing to men having to circulate on the roofs of steam trains in Victoria Station, the height of the trolley wire inside the station is 19 ft. 9 in. above mean rail level, and the drop from this level to the level under the bridges is 5 ft. 10 in., which is dealt with as a gradient of 1 in 10, as the maximum speed at which the gradients have to be taken does not exceed 25 miles per hour. In order to avoid danger of short-circuits, a neutral section is interposed between the live wire and the earthed section under the bridge. The contours of these sections have been designed in such a way that they take care of the inertia of the bow and the rapidity with which it rises and falls, with the result that there is practically no hammering of the bow when entering or leaving these sections.

The line has been divided into sections which can, if necessary, be isolated from each other with a view to locating faults and to minimising any delay that might be caused thereby.

The only satisfactory manner of sectionalising the line without limiting the speed at which trains can traverse such sections is by the use of air-gaps at the end of each section. Under ordinary conditions, and where there are no complicated crossings or junctions, this is a very easy matter, as one conductor can be brought to a terminal and anchored whilst another conductor is started at the point of section, so that the collector bow on a short section runs in contact with the conductor wires of two adjacent sections.

However, at certain points and crossings and complicated junctions this was found to be a very difficult matter. Both in Germany and the United States this difficulty has been met by putting in section insulators mechanically connecting the adjacent sections. Experience has shown that this method caused flashing and knocking of the bow collector, causing complications and limiting the speed at which such connections can be negotiated. This difficulty has been entirely overcome by a special patented device designed for the Brighton Railway.

(To be concluded.)

Discussion.

Mr. R. T. Smith, president, took the somewhat unusual course of opening the discussion himself, and said that the results obtained on the railway system described in the paper were unsurpassed anywhere in the world. It had been shown that when the corrosive influence of smoke from steam locomotives operating over an electrified line could be eliminated the cost of maintaining an overhead system would compare favourably with that for a 3-rail system. If the system was not subjected to steam corrosion the cost of maintenance would be very small indeed. He thought the most interesting part of the paper was the set of curves; a careful study of them would reveal an immense amount of information. With regard to clearances, he thought that 4 in. vertical and 3 in. horizontal clearance would be accepted everywhere as standard when working at 11,000 volts. The conditions imposed on the District Railway concerning pressure drop had necessitated the 4-rail insulated return system being adopted, and other London railways had to follow suit for through running purposes. There were, however, other railways which used very much higher pressure drops, and there was no evidence that corrosion had resulted from the use of drops even as large as 150 to 200 volts.

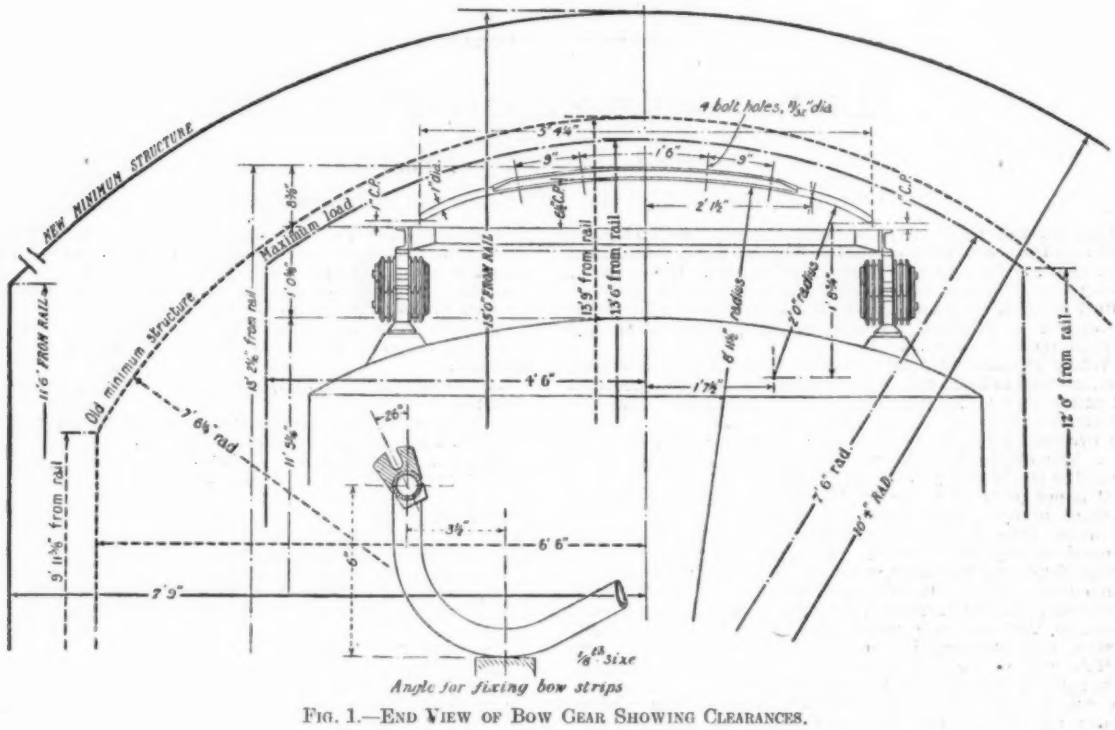


Fig. 1.—End View of Bow Gear Showing Clearances.

Mr. J. Dalziel (Midland Railway) wished to know why the 2,500-volt 3-rail system had been abandoned in the U.S.A. He did not see the object of increasing the pressure to 15,000 volts; it would not be any safer than 2,400 or 3,000 volts, and the maintenance cost would not be reduced either. However, 600 volts was much too low a pressure for main line electrification. On the Midland Railway a great many crossings, intersections, and complicated junctions existed, and on this account high-speed conductor shoe working was very problematical. The difficulty could not be overcome by using short overhead equipment over crossings, &c., because they would be very numerous, and would necessitate the raising and lowering of the collector bow very frequently. This operation was sure to be neglected, with consequent damage and breakage of bows. Further, in long tunnels, &c., water continually dripped from roof and sides on to the track, and such positions were much too damp for 3-rail working. It was his opinion that the overhead system was much the better for main line electrification. This system would not interfere

with track maintenance, and it need not be expensive. There was prejudice in this country against using wood poles, but the life of wood telegraph and telephone poles was as long as 40 years. With regard to the author's statement that "an overhead conductor can only be utilised where the currents to be collected from it are relatively small," the speaker drew attention to the fact that on the Chicago, Milwaukee, and St. Paul Railway they were able to collect, at 3,000 volts on the double trolley wire with a double shoe and quadruple contact, currents of 2,000 to 4,000 amps.; it was, however, desirable to use a single bow if possible. He thought it possible that electrolysis troubles with main line electrification would be non-existent.

Sir JAMES BALL explained that he had at first anticipated experiencing trouble due to the overhead equipment in connection with track maintenance work. When such work was actually carried out, however, the overhead equipment had proved to be a blessing. They were not only able to use electric light, and so keep the atmosphere, particularly in tunnels, &c., sweet and clean, but they were also able to work on the track without any inconvenience from live rails.

Mr. H. E. O'BRIEN thought that both the overhead and conductor rail systems had grave disadvantages. Could they always find sufficient space on which to erect the steel work that carried the overhead conductor? and what percentage of the total cost did the cost of such steel work come to? The conductor rail system was so simple that it was possible to estimate within 5 per cent. what its cost would be. This could not be done with the overhead system, on which a considerable amount of work must be completed before they could form an idea of what the total cost would be. Conductor rail systems were, on the other hand, a nuisance to the ground staff, and if they were going to increase the pressure there would be some difficulty in guarding the live rails. Even 600 volts was treated with a considerable amount of respect, and when they used higher pressures the guarding should be such as to make it practically impossible to receive a shock. The present method of guarding the rail was of little use; it might be efficient when new, but there was considerable danger when old. A 3-rail in the form of an inverted channel that had been used by the Great Western Railway seemed to be well designed, and he wished to know why it had not been copied. In his opinion, some form of hybrid system would have to be adopted; at complicated junctions the rail gaps would not be excessive, and the overhead structures to bridge such gaps need not be serious. He hoped that all restrictions placed upon railways with regard to electrolysis might be entirely removed in the near future.

Mr. H. W. FIRTH thought the results obtained as described in the paper were very satisfactory. Concerning which system should be adopted, that was practically a question of voltage; the removal of the obstruction of a third rail from the track was also a great advantage. Methods of protecting the rail, even with 600 volts, were not to be trusted. The protection should be entirely free from the rail, as was the case in New York, and not bolted to it. With regard to the restrictions imposed concerning pressure drop, &c., something should be done to modify the present state of affairs, and it was also desirable to simplify the overhead system. If the conductor rail system were used in large shunting yards and junctions, considerable inconvenience and danger would be experienced by shunters who had to continually walk along and cross the track. With regard to the costs of the two systems, it was misleading to compare the costs of parts of the two systems; the cost of the whole system should be considered and not part of it only.

Mr. G. L. DRURY (North-Eastern Railway) exhibited a collecting bow which had run for over 8,000 miles, and also contact strips of a 4-strip bow which collected 125 amp. per contact, to demonstrate the heavy punishment received by bows when doing heavy work. He pointed out that the author had omitted to mention his experience of interference by lightning. They, the speaker's company, had not had any trouble in this connection with their locomotives, but they used lightning arresters on their overhead systems.

Mr. H. M. SAYERS said that as a user of the railway system described he had found it very free from delays. The overhead structure, however, looked heavier and more expensive than it might have been. It was better to err on the side of safety, but at the same time it was desirable to simplify as much as possible. The speaker showed slides of overhead work in America and elsewhere, showing that single catenary or much lighter and cheaper construction could do the work satisfactorily. The third rail was a nuisance on the track. With regard to wear, he thought it better policy and cheaper to sacrifice the bow to the conductor wire. Due to the frequency that was used the interference with neighbouring telegraph circuits was much greater than with telephone circuits. Concerning costs, one could not say that one system was cheaper than the other, but with the overhead construction higher pressures could be used.

Mr. G. W. PARTRIDGE asked the author for information about the failure of insulators due to lightning; also in connection with the double insulators used, how could they tell when one of the pair had failed? By the use of static transformers to reduce the pressure it would be a simple matter to run on a 3-rail through tunnels, especially on single-phase systems, as was the case under discussion. The wear on bows was much greater with D.C. than when A.C. was used.

Sir P. DAWSON, in reply, explained that it had been found possible to cross from a third-rail to an overhead system at high speed without any difficulty. As regarded costs, he was willing to estimate and fix the price of an overhead system to within 5 or 6 per cent. before work was commenced. He agreed that the system described was a heavy one, but at the time it was built they could not afford to take any chances, and had, therefore, tried to make failure impossible. They had been particularly fortunate in connection with the signalling, and had practically no alterations to make to signals on electrification. The 2,400-volt 3-rail system was dropped in the U.S.A. on account of trouble with overpressures due to the make and break, leading to motor burn-outs. A one-bow strip when running at full speed would collect 40 amps.; the maximum was 130 amps. The cost of maintaining the bow strips was very small, and the aluminium of the old bows was of considerable value in making new ones. They had been very free from trouble due to lightning; he did not remember the fracture of a single insulator, and believed it was a fact that the higher the pressure used the less trouble was experienced. The use of arresters on the trains gave more trouble than they were worth, and they had abandoned them. The use of transformers as suggested by the last speaker would increase the cost, and their operation in practice was not so simple as it appeared in theory.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Single-phase Meters on Three-phase Three-wire Systems.

In your issue of June 11th, Mr. H. G. Solomon writes in his article "Single-phase Meters on Balanced 3-phase Systems" "that the use of one single-phase meter to register the consumption of energy in a 3-phase network is still largely prevalent."

The current coil of the meter is connected in one line, and the voltage coil across that line, and any of the two remaining. The number of units registered on this meter is then multiplied by 2 to give the total consumption of the 3-phase load.

This is a connection I could hardly credit anyone knowing anything about 3-phase power measurement being capable of making. The accuracy, as Mr. Solomon points out, depends on the power factor of the motor being exactly unity, as well as the load being balanced. The load, if an induction motor, may be balanced, but the power factor is never unity, no matter what load the motor is working against.

The price of 3-phase 3-wire balanced or unbalanced meters at the present time makes their use almost out of the question for small motors, so that the use of a single-phase meter (when the neutral point of the system is available) can be resorted to. The single-phase meter reading is then multiplied by 3 to give the total energy consumed in the circuit. I have tried this method, connecting at the same time a 3-phase 4-wire meter in the same circuit. The consumption as registered by the single-phase meter is in some cases exactly one-third that measured by the 3-phase 4-wire meter, whilst in other cases it is as much as 10 per cent. to 20 per cent. short of the third.

The price of a 3-phase 4-wire meter is not very much more than that of a 3-phase 3-wire balanced meter, and is less than that of a 3-phase 3-wire unbalanced meter.

Even with a small motor which is running continually, the loss due to the use of a single-phase meter connected to the neutral point of the system can be quite considerable, sufficiently so to warrant the use of the 3-phase 4-wire meter, and on a system with earthed neutral there is no other accurate meter for 3-phase power measurement but the meter which is connected in every line of the system, *i.e.*, the 3-phase 4-wire meter.

D. Sclar.

Cowdenbeath.
June 28th, 1920.

Fault Localisation.

May I express to Mr. T. D. Spark my hearty appreciation of the admirably clear description contributed by him to the ELECTRICAL REVIEW of July 2nd relative to the methods he employed in localising the cable fault first referred to by him over the pseudonym "Kondenser" in the REVIEW of May 7th?

Likewise, one welcomes so useful an example of fault localisation as that described in the letter from your contributor "J. W. H." in the REVIEW of June 18th.

Similar, however, as may be both these excellent examples of faults successfully localised by apt application of theoretical principles, there is one salient feature in which both these examples differ radically from the case described by the present writer in the REVIEW of June 4th.

In this third-mentioned case—as shown in the writer's article here referred to—ordinary capacity methods, even with lowest practicable E.M.F., *proved of no avail* owing to the static charges *getting past* the high-resistance semi-metallic film on the india-rubber insulator surrounding the broken conductor.

Under these circumstances, it was only by adoption of means described in the ELECTRICAL REVIEW of June 4th that—in this third case—localisation became possible.

If any other method can be shown to be successful under like conditions, the present writer would be grateful to be informed about it.

E. Raymond-Barker.

London, W.
July 5th, 1920.

Staff Salaries and Conditions of Service.

In a leading article in your issue of June 4th, on certain questions affecting salaries and conditions of service of technical engineers, you suggested that such matters might with advantage be brought to the notice of the Joint Industrial Councils. A difficulty, however, arises, does it not, in the fact that such Joint Councils have as yet been constituted in small sections only of the engineering industry, and that there does not appear to be any prospect of such Councils of Employers and Workpeople, with the wider powers contemplated in the report of the Whitley Committee, being set up, in the near future, in connection with the engineering manufacturing industry. Both the employers and the manual workers appear, at present, to be satisfied that their old-established Joint Conciliation Boards meet their needs. Moreover, it would seem that such Joint Councils of Employers and Workpeople would hardly be in a position to deal with the questions which arise in connection with the relations between employers and technical staffs. The Provisional Executive Council of the Society of Technical Engineers inclines to the view that as an alternative to the formation of Whitley Councils in the engineering industry the setting up of Joint Boards of employers and technical staffs, comparable with the board which has been constituted for the electricity supply industry, might with advantage be considered for other sections of the industry.

In the concluding paragraph of your article you were good enough to suggest that, "so far as the field remains uncovered," this society "is the body to look to for appropriate action," and you suggest further, that we "should abandon, at least in part, our customary secretiveness and tell the public something of our aims and work."

In your issue of June 25th your correspondent, Mr. Garton Le Roet, refers to this society, and expresses his opinion that it has fallen a victim to paralysis, that its Council has abandoned all attempts to control the actions of its paid servants, and that it has failed to publicly proclaim a definite policy, and to secure the help of technical journals and friendly employers. He remarks further, that its public utterances are chiefly notable for their contradictory character, and that at a meeting which he attended the speakers voiced a wholly opportunist policy. He concludes by suggesting that "the efforts of all men who have the interests of the industry at heart should be directed towards making both employés, staff, and what is usually called Labour, realise that the technical and management staffs in the engineering industry (and for that matter in all industries) are, and must remain, a *third party* in industry."

May I remind your correspondent that the period of gestation of an organism varies with the size and complexity of the adult, so that it takes almost as many months to produce a whale as it takes days to make a mouse. The promoters of this society have planned its constitution in the view that, when fully formed, it will have to live in a complex environment, and will need an organisation to correspond. May they hope that when fully grown the society will resemble a whale rather than a mouse in size?

As to the charge of your correspondent that the society has failed "to publicly proclaim a defined policy," I would suggest to him that there are two ways in which a society such as this may be run. On the one hand, it is possible for an Executive Council to determine and proclaim the policy of a society and expect its members to acquiesce; but, on the other hand, it is possible for the governing body to act on the assumption that its members are educated and responsible persons, and that it is desirable, before seeking to elaborate a policy, to obtain the considered opinions of those members, on questions of vital importance to them. The promoters of this society have adopted the latter course. When your correspondent states that the public utterances of this society "are chiefly notable for their contradictory character" I am not able to follow him, since the only authorised public utterances of the society of which I am aware have been devoted to a discussion of the theorem which your correspondent himself thinks so important, namely, that "the technical and management staffs are, and must remain, a *third party* in industry."

In regard to your own proposal that "we should abandon our customary secretiveness," may I suggest that there is nothing sinister in such secrecy, and that indeed this "secrecy" is nothing more than a proper reserve in regard to a general scheme, the details of which are under consideration. The fact is that as the founders of the society have somewhat ambitious aims as to the range and possible future scope of the society, they have thought it best not to proclaim those ambitions too loudly before the foundations of the society were laid and its constitution settled. That stage has now been reached. Local and Central Councils are now being elected under approved rules and by-laws, and will take office shortly. The society will then be in a position to consider in detail the problems which face it, and to deal with them within the limits of a defined constitution. I shall be glad to send particulars of the society to any of your readers who may care to communicate with me, and hope in the near future to be in a position to ask your sympathetic consideration of its aims and objects and the methods by which it is hoped to obtain them.

Norman Wyld,
General Secretary, Society of Technical Engineers.

102, Belgrave Road,
London, S.W. 1.
July 6th, 1920.

I have read with much interest your recent reference to the above, and the following letter by Mr. Gaston Le Roet. I will leave the details of this letter to be answered by abler pens than mine, but would be glad of a small space to offer a few remarks.

In the first place, it is admitted on all hands that some such organisation as the S.T.E. is an absolute and imperative necessity if the technically trained man is to occupy his proper niche in State building, to improve his status and emoluments, or *even retain his present invidious position*!

Yet such an organisation is exceedingly difficult to set up, primarily, I think, because the average engineer is extremely independent, and has learnt to rely very much upon his own resources. And it has proved a very difficult task to co-ordinate the thousand and one views on every detailed point that has arisen. I cannot help thinking that if Mr. Le Roet had joined the S.T.E. and taken part in the setting-up of its constitution, he would have been rather less severe in his criticisms. And one of the, to my mind, most astonishing things is the large number of engineers who have deliberately stayed outside the ranks of the S.T.E. (while admitting its necessity), and stated as their reason that they "will wait till something definite has been done by the S.T.E." How any engineer can be capable of offering such an illogical reason passes my comprehension. For is it not obvious that the S.T.E., or any other organisation, can do nothing until it has the majority, at least, in its ranks of the men it professes to represent? All such men who are wavering I would earnestly ask to join up at once, and give of their best to help those who have made a start in the face of very great difficulties towards establishing a powerful and representative Society of Technical Engineers.

In conclusion, I would state that, as far as I am aware, it has been the settled policy of the S.T.E. to be *a third party* in the State; and also that it has never proposed to standardise salaries.

Let us all, therefore, sink our individualistic tendencies in this matter and join the S.T.E. We shall *stand*, in the industrial strife and competition of the future, only if we are united; and thus only can we make ourselves heard by the nation and its Parliament. As Abraham Lincoln said on a notable occasion: "If we don't hang together, depend upon it we shall hang separately."

C. F. Waddington.

Bristol.
June 30th, 1920.

Technical Books.

The plea so admirably put forward by Mr. Purday and Mr. Fred Bland for reform in the making of technical books, deserves to be supported by all who desire to assist progress in British science, literature, and industry. Charles Darwin taught us to regard books as tools to be adjusted to the needs of the work before us. He would cut a heavy volume in half to make it more convenient to hold. If he had lived to see the modern engineer's year book, he would have divided it into quarters to make it more convenient to lift. There was never a more delightful technical book than the old edition of Deschanel's Natural Philosophy when it appeared in separate parts. In a single mixed volume, how stolid it is. Those colossal creatures whose bones were formed for our amazement, and whose very names were too long for comfort, died of bigness, awkwardness, and forgetfulness. It is a pity that bookmakers do not more often go to the Natural History Museum.

During the war the problem how best to record technical progress frequently arose. So far as the Admiralty was concerned it was solved by the issue of a continuous series of separate pamphlets. Each pamphlet was restricted to a single subject, and was written by an officer or by a group of officers, who had specialised in that subject. The pamphlets were all of the same size (13 in. by 8 in.), and each was given a serial number. Indexing was simplified, because references were to the serial number and page. It was proposed to issue a complete index every five years, and an interim index when necessary.

For practical purposes the requirement among engineers is a series of pamphlets, each restricted to an account of the

present state of knowledge concerning a particular subject, the whole series to be indexed. Paper covers are good enough. The cost of production of such pamphlets, even in 1919-1920, was not prohibitive. If the new Institute of Physics would undertake to publish a series of this kind it would confer a great benefit upon present and future technical workers. Awaiting publication, the index should be on cards, and the items for the index should be entered upon the cards within two weeks of the issue of any given pamphlet. The card-index should be available for reference at the Institute of Physics.

Rollo Appleyard.

July 4th, 1920.

Adieux en Route.

I had no time for farewells, so make use of your columns for the same. I am off to Malaya on tin mine engineering.

The Marconi operator repeated one of the old ones which may amuse readers: "Given two similar bars of steel, one magnetised and the other not. Decide which is which without use of any other apparatus."

H. M. Taylor.

Port Said.
June 24th, 1920.

The I.M.E.A. and the National Joint Board.

Considerable discussion took place at the general meeting of the Incorporated Municipal Electrical Association, recently held, with respect to Mr. Alderman Jephcott's resolution regarding the acceptance by local authorities of recommendations of the National Joint Boards under the Whitley scheme. There would have been, I think, even more discussion, had not the shortness of time available made it necessary to apply the closure. I venture to think that the mover of the resolution had the unanimous support of the meeting with reference to recommendations of the National Joint Industrial Councils. A difficulty shared by the writer, however, lay with the application of the resolution to the National Joint Board. This was not, I think, due to any objection, generally, to the terms of the resolution applying to a Council, duly appointed and duly recognised, to deal with the matter of staff salaries. It did, however, appear that the resolution as put to the meeting, if passed, could be taken as giving authority to the National Joint Board as now appointed, to continue to make recommendations.

There is real difficulty in dealing with staff matters of publicly-owned commercial undertakings by means of Joint Councils, and the method adopted in the formation of the National Joint Board has placed the managers of many electricity undertakings in a most difficult position when discussing matters arising out of its recommendations, with their respective committees.

It would appear to the writer that when the Incorporated Municipal Electrical Association was invited to provide half the employers' side of the Board, it should have obtained a mandate from the constituent authorities before accepting the invitation. By giving such a mandate the various authorities would have been morally committed to abide by any decision arrived at. There is little doubt in the writer's mind that such authority would have been given, probably unanimously, and it would then have been necessary to discuss the method of election of the six nominees of the Association. This, I venture to suggest, is not a matter for the Council of the Association, but a matter for the general meeting. Whilst the Council, as then formed, could have dealt with matters of urgency, as, for instance, arbitration cases, its first duty would have been (following the example of the Industrial Councils) to form District Councils, and instead of the National Council formulating a scale of salaries applying to the whole country, the matter would have been properly referred to the District Councils, and their recommendations subsequently submitted to the National Council for confirmation.

Apparently the nominees of the I.M.E.A. on the Joint Board for this year have yet to be appointed, and it was a matter of very considerable surprise to the writer that no reference whatever was made to the appointment of these gentlemen at the recent conference of the I.M.E.A.

As the matter stands at the present time it would appear there is likely to be anything but unanimity in accepting the recommendations of the Board by the various authorities.

C. Nelson Hefford.
City Electrical Engineer and Manager.

Leeds.
June 30th, 1920.

I shall be pleased if you will clear up the following:—

The I.M.E.A., at the business meeting at Ilkley, on Friday, June 25th, passed the following resolution. I quote from three papers:—

Yorkshire Post, Saturday, June 26th, 1920.—"Another interesting discussion was introduced by Ald. Jephcott, M.P. (Birmingham), who moved a resolution (which was carried), stating that to avoid misunderstanding the Association desired that all individual undertakings be advised that it is their opinion that all awards, agreements, or recommendations of the National Joint Board should be observed."

Electrical Times, July 1st, 1920, page 3.—"Whitley Councils. This Association in general meeting desire that all individual undertakings shall observe all agreements, recommendations, or awards emanating from a Whitley Council of the Joint Board."

ELECTRICAL REVIEW, July 2nd, 1920, page 6.—"And that all awards of the National Joint Board or Council should be loyally observed."

Can you, in your next issue, give the correct wording of this resolution, and say whether it relates to the National Joint Board for staff members, or to the National Industrial (Whitley) Council for workmen, or to both?

Confused.

July 5th, 1920.

[To both, as we indicated. The exact wording of the resolution is as follows: "This Association in general meeting desire that all individual undertakings shall observe all agreements, recommendations, or awards emanating from a Whitley Council or Joint Board."—EDS. ELEC. REV.]

What is the Contractor Doing?

After reading Mr. Blake's remarks, one would come to the conclusion that there is a sad lack of real interest taken in the commercial sales side of the business. Unfortunately this is the case with most contractors, who generally are satisfied with having their front windows all dressed up with paint and nothing for the man in the street to see but those magic letters "Electrical Engineers and Contractors." Fortunately there are others who turn their thoughts on making hay while the sun shines, and who make heroic but unsuccessful attempts to attract the eyes of the public to their goods; but this is all in vain, due to the want of "flash" advertising and publicity matter, and the necessary expense in creating artistic show-room facilities. If manufacturers would follow in the footsteps of their American brethren and co-operate with contractors, they would find that British industry and goods would be first past the post in the great race for the home trade which has still got to be won.

J. B. Epstein.

Glasgow. *June 28th*, 1920.

Composition v. Porcelain Insulators.

In your issue of June 18th, you published a letter from Messrs. Thomas De La Rue, replying to my letter published in your issue of June 4th, in which I took exception to this firm disparaging porcelain in favour of their own composite material "Telenduron."

I showed that the figures published by them of tests taken by the N.P.L. on "Telenduron" really showed the inferiority of "Telenduron" against porcelain as regards electrical strength, and hence that this material is not suitable for high-tension work, for which they also claim it.

Messrs. Thomas De La Rue now say that for high-tension work they make other grades of "Telenduron." For these other grades to be of any use for high-tension work, they would have to be vastly better electrically than the grades of which they give tests. For Messrs. Thomas De La Rue to be able to say that these other grades are suitable for high-tension work they would need to have had tests on these also (otherwise how can they know?), so perhaps they will publish tests on such other grades to substantiate their electrical fitness for high-tension work, or else withdraw their assertion.

Geo. V. Twiss.

London. *June 29th*, 1920.

High-pressure Direct-current Transmission.

Could you kindly tell me, through the medium of your valuable journal, what are the drawbacks to the use of extra-high-pressure continuous currents?

If I am correctly informed, no system over a thousand volts D.C. is in existence in this country. Is commutation the trouble, or transmission?

Ignoramus.

June 28th, 1920.

[The difficulties reside solely in the generating and converting machines, which cannot be built as yet for large powers at pressures above, say, 5,000 volts. Consequently machines of about 1,000 KW., generating at 5,000 volts, have to be coupled in series to attain the necessary high pressure for transmission, and similarly at the receiving station motors of 1,000 KW. or so have to be employed, several of which may be coupled to one generator. In transmission, direct current at high pressure is far superior to alternating current; it requires the minimum amount of copper, has no dielectric loss, involves the cheapest construction of overhead line or underground cable, has no capacity current, can be used with an earth return, and does not affect telegraph or telephone communication. Underground cables can readily be made to work at 100,000 volts D.C.

The only such system at work in this country, to our knowledge, is that laid down by Mr. J. S. Highfield for the Metropolitan Electric Supply Co., Ltd., in 1911. See ELECTRICAL REVIEW, June 14th and 21st, 1912, and June 20th, 1913.—EDS. ELEC. REV.]

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

16,650. "Automatic electrical adjusting device." G. Wallace. June 21st.
16,651. "Machine for stripping rubber, &c., from electric cables, &c." G. Wallace. June 21st.
16,672. "Method of securing metal contact or electrical continuity between unscrewed tubes and fittings in conduit wiring systems." E. J. Stockwell. June 21st.
16,680. "Electric contact-makers and circuits connected therewith for railways, &c." N. P. Roe. June 21st.
16,682. "Electric contact-breaker for railways." N. P. Roe. June 21st.
16,683. "Bracket for attaching electric contact-breaker to locomotives." N. P. Roe. June 21st.
16,692. "Radio-telephony." L. L. Jacquot. June 21st. (France, June 20th, 1919.)
16,695. "Testing electric cables." C. F. Street. June 21st.
16,701. "Electrostatic plant for depositing dust, &c., from gases." Skinningrove Iron Co. and T. R. Smith. June 21st.
16,705. "Support for telephone receivers." D. Yellin. June 21st.
16,726. "Process for electrical gas purification." J. E. Lilienfeld & Metallbank und Metallurgische Ges. June 21st. (Germany, August 8th, 1918.)
16,737. "Rectifiers." Siemens-Schuckertwerke. June 21st. (Germany, June 10th, 1916.)
16,739. "Ignition magnetos for internal-combustion engines." P. J. M. Lefevre. June 21st. (France, March 27th, 1919.)
16,745. "Lifting magnets." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). June 21st.
16,747. "Electrical distribution and power-transmission systems." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). June 21st.
16,806. "Automatic switches for relay circuits, &c." Austin Motor Co. and C. B. Walker. June 22nd.
16,817. "Block signalling systems." J. Bethenod. June 22nd.
16,818. "Two-way rectifying crystal receiver for radiotelegraphy." R. S. Spreadbury. June 22nd.
16,835. "Means for suspending electric lighting bowls, &c." F. W. Hollingsworth. June 22nd.
16,838. "Eectrical contacts of the pug-and-socket type." H. J. S. Thomas. June 22nd.
16,847. "Electric burglar, &c., alarms." T. Gunn, Ltd., and H. J. Tibbles. June 22nd.
16,860. "Magneto-electric machines." British Thomson-Houston Co. and A. P. Young. June 22nd.
16,862. "Electric power-generating sets." A. Biro. June 22nd. (Hungary, February 3rd, 1919.)
16,883. "Electric incandescent lamps for polyphase currents." E. Gerard. June 22nd. (Belgium, November 26th, 1913.)
16,911. "Electric starting devices for internal-combustion engines." R. Bosch Akt. Ges. June 22nd. (Germany, May 26th, 1919.)
16,912. "Commutators, &c." R. Bosch Akt. Ges. June 22nd. (Germany, April 29th, 1919.)
16,918. "Telegraph cables." H. W. Sullivan. June 22nd.
16,944/5. "Electrical switchgear." W. A. Coates, D. R. Davies, G. E. Gittens and Metropolitan-Vickers Electrical Co. June 22nd.
16,950. "Commutator for electric dynamos, motors, &c." H. Rowlands. June 23rd.
16,977. "Electric switches." J. C. White. June 23rd.
16,980. "Two-phase high-frequency electric alternating-current generators." M. C. A. Latour. June 23rd.
16,999. "Arrangement for controlling length of conversations for telephones, &c." Automatic Telephone Manufacturing Co., P. T. Bates and A. V. Newell. June 23rd.
17,000. "Telephone systems." Automatic Telephone Manufacturing Co., R. Mercer and J. Savin. June 23rd.
17,003. "Electric switch." J. Beissbarth. June 23rd. (Germany, January 31st, 1919.)
17,005. "Electro-magnetic feeding devices for machine tools." F. Werner. June 23rd. (Germany, February 26th, 1916.)
17,011. "Magnetos for internal-combustion engines." E. J. Pilblad. June 23rd.
17,030. "Switch on and off installation for electric circuits." F. Sinzig and H. Wenger. June 23rd. (Switzerland, October 9th, 1919.)
17,042. "Heavy-current relays." E. C. R. Marks (Gleirichter Akt. Ges.) June 23rd.
17,047. "Telegraphic reception." Siemens & Halske Akt. Ges. June 23rd. (Germany, September 27th, 1918.)
17,048. "Typewriting telegraphs." Siemens & Halske Akt. Ges. June 23rd. (Germany, December 16th, 1918.)
17,049. "Suspension insulators." Siemens-Schuckertwerke. June 23rd. (Germany, November 29th, 1919.)
17,053. "Heating device in electrical resistance furnaces." Allgemeine Ges. für Chemische Industrie. June 23rd. (Germany, March 13th, 1919.)
17,074. "Electric lighting systems for automobiles, &c." J. S. Withers (L. Renault). June 23rd.
17,077. "Electric battery lamps." F. J. Turquand. June 23rd.
17,081. "Electric lampholders." H. Garde. June 23rd.
17,082. "Electrical fittings." H. Garde. June 23rd.
17,085. "Electrically-operated speed regulators." Duplex Engine Governor Co. June 23rd. (United States, June 23rd, 1919.)
17,103. "Electric arc lamps." H. Jackson. June 24th.
17,123. "Locking devices for electric, &c., hoists." J. Barker & Sons and J. Saxton. June 24th.
17,132. "Electric current interrupters." C. E. Bennett. June 24th. (United States, June 24th, 1919.)
17,135. "Method of electrically welding steel." J. W. Plant. June 24th.
17,144. "Electric diaphragm alarms." Apollo Plug Manufacturing Co. and F. Brown. June 24th.
17,189. "Dynamo-electric machines." Siemens-Schuckertwerke. June 24th. (Germany, July 25th, 1919.)
17,195. "Fluid-actuated and electrically-actuated boring and drilling machines." W. Kühn. June 24th.
17,217. "Ignition apparatus of submarine mines." S. J. Williams. June 24th.
17,228. "Terminals for electric cables, &c." A. E. Parnacott. June 24th.
17,239. "Distributing and draw-in boxes for electric installations." A. Bakker and Bureau voor Uitvinders. June 24th.
17,273. "Receivers for telephony and telegraphy." A. W. Dransfield. June 25th.
17,319. "Circuit making and breaking device." E. Schattner. June 25th.
17,321. "Sparking plugs." P. Mei. June 25th.
17,334. "Dynamo-electric machines." Siemens-Schuckertwerke. June 25th. (Germany, September 6th, 1919.)
17,335. "Dynamo-electric machines." Siemens-Schuckertwerke. June 25th. (Germany, January 13th, 1917.)
17,348. "Electrolysers." R. Pechkranz. June 25th. (Switzerland, June 27th, 1919.)
17,351. "Electric heating apparatus." M. R. Malhomme. June 25th. (France, August 19th, 1919.)
17,353/9. "Apparatus for detecting and determining direction of wave energy." Steward Davit & Equipment Corporation. June 25th. (United States, June 25th, 1919.)
17,356. "Directive sound transmission." Stewart Davit & Equipment Corporation. June 25th. (United States, June 25th, 1919.)
17,357. "Devices for detecting and determining direction of sounds." Steward Davit & Equipment Corporation. June 25th. (United States, June 25th, 1919.)
17,358. "Method of sounding and determining distances." Steward Davit & Equipment Corporation. June 25th. (United States, June 25th, 1919.)
17,360. "Electric compensators." Steward Davit & Equipment Corporation. June 25th. (United States, June 25th, 1919.)
17,394. "Electrical quick make-and-break switches." H. C. Sanders. June 26th.
17,405. "Casings for electric lamps." J. Bein. June 26th.
17,408. "Magnetic motor." D. Suchostawer. June 26th.
17,413. "Electro-magnetic wave-receiving and transmitting arrangements." Soc. Francaise Radio-Electrique. June 26th. (France, November 3rd, 1916.)
17,471. "Electro-magnetic relays." Creed & Co. and T. Lenaghan. June 26th.
17,472. "Voltaic batteries." G. Calvert. June 26th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

17,794. "Electric lampholders." T. J. Jones. April 30th, 1919. (143,941.)

1919.

1,363. "Dynamo-electric machines." Bruce Peebles & Co. and C. J. Hunt. January 20th, 1919. (143,945.)
1,985. "Supporting device for overhead electric trolley wires." F. W. Fawdry and P. Dawson. August 19th, 1919. (143,946.)
2,197. "Electric signalling systems comprising amplifying or repeating apparatus." Western Electric Co. (Western Electric Co.). January 20th, 1919. (143,949.)
2,487. "Apparatus for generating electric currents." Splitdorf Electrical Co. June 8th, 1918. (128,190.)
4,592. "Electro-mechanical pocket lamps." K. K. Krag-Moller. February 24th, 1919. (143,958.)
5,573. "Electric smelting furnaces." I. Hole. April 11th, 1918. (125,363.)
5,841. "Direct-current motors and generators." G. Stirk and J. G. Stirk. March 10th, 1919. (143,980.)
5,964. "Electric lamps for motor-vehicles or for other purposes." G. A. Edman. March 11th, 1919. (143,985.)
6,610. "Contacts of electrical switchgear." R. S. O'Neil. March 17th, 1919. (143,993.)
7,879. "Electrical switches." S. W. Hamlyn. March 28th, 1919. (144,009.)
8,827. "Electric vehicles." W. Rogers. October 7th, 1919. (144,021.)
8,989. "Dynamos." E. A. Watson and M.L. Magneto Syndicate. April 9th, 1919. (144,024.)
13,094. "Protective gear for alternating-current systems." H. Pearce and Metropolitan-Vickers Electrical Co. May 24th, 1919. (144,073.)
13,199. "Radio-signalling systems." British Thomson-Houston Co. (General Electric Co.). May 26th, 1919. (144,075.)
15,489. "Ignition attachment for the prevention of loss by theft of motor-vehicles under their own power." T. A. Kirton. June 20th, 1919. (Cognate application 23,174/19.) (144,107.)
15,544. "Electric switches." F. M. Burrell and C. W. Smith. June 20th, 1919. (144,108.)
17,073. "Electric circuit controllers." R. Amberton. July 8th, 1919. (144,122.)
18,326. "Storage battery locomotives." Mancha Storage Battery Locomotive Co. August 31st, 1918. (132,234.)
21,514. "Combined telephone and telegraph systems comprising amplifying or repeating apparatus." Western Electric Co. September 2nd, 1919. (Addition to 143,949.) (144,152.)
21,568. "Magneto-electric ignition machines." Scintilla. September 2nd, 1918. (132,257.)
25,516. "Dynamo-electric machines." Baron Clifford of Chudleigh (W. H. Clifford). October 17th, 1919. (144,175.)
26,485. "Electrical installations for controlling electric pianos and other apparatus." C. Audran. July 18th, 1919. (144,182.)
26,496. "Selective electric switching-devices." Allmanna Telefonaktiebolaget L. M. Ericsson. December 11th, 1918. (138,593.)
27,026. "Trolley-heads for electric tramcars." F. Sharp and J. Martin. November 3rd, 1919. (144,183.)
27,923. "Bushings for electric conductors." British Thomson-Houston Co. (General Electric Co.). November 11th, 1919. (144,191.)
28,448. "Control of asynchronous electric motors." Siemens-Schuckertwerke Ges. August 31st, 1918. (135,480.)
31,990. "Magnetic toy." J. J. Tyndall. December 20th, 1919. (144,211.)

1920.

2,727. "Magnetic separators." F. Uhlig. October 10th, 1919. (144,221.)
5,030. "Arrangement for protecting telephone installations from currents of dangerously high tension." A. Perego. November 23rd, 1918. (139,198.)
7,235. "Magneto-electric ignition apparatus." H. G. C. Fairweather (Aktiebolaget Svenska Elektromagneter). March 10th, 1920. (144,234.)

Cape Town Electrical Dispute.—The dispute between the Electrical Contractors' Association and the Electrical Trades Union has been referred to a Joint Board composed of an equal number of employers and employés in the building trades, with a neutral referee. This Joint Board has been formed for the purpose of adjusting all differences arising in the building and allied trades. Each trade sends a delegate to the Board representing the employer and another delegate representing the workmen. Mr. Bird, of the Kitson Lighting Co., represents the Electrical Contractors' Association on the Board.